

DARIEN RADIO STATION - THEN AND NOW -

Restoration, preservation, and tourism
promotion of some Panama Canal
historical sites in abandonment

Jaime Massot Hernández

Panamá

2022

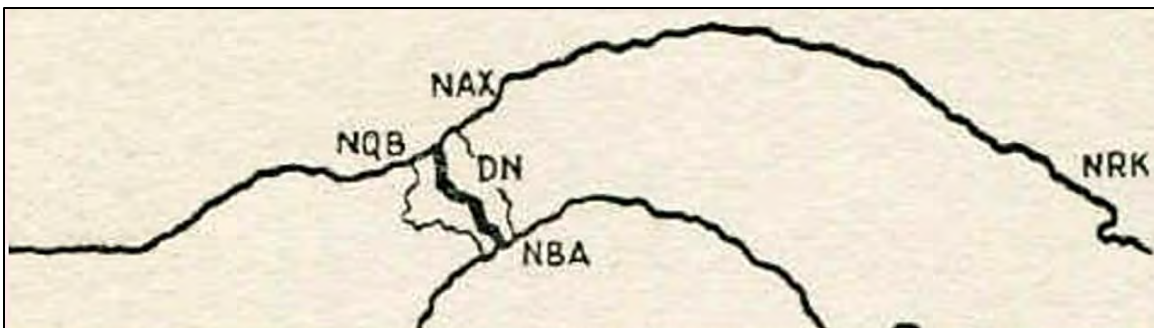
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Dedication

To my beloved canine companions, who have filled my days with joy, loyalty, and boundless love. Your wagging tails and playful antics have taught me the true meaning of unconditional friendship. This book is dedicated to you: Wawo, Wawa, and Wawin, for being my constant companions and faithful friends.

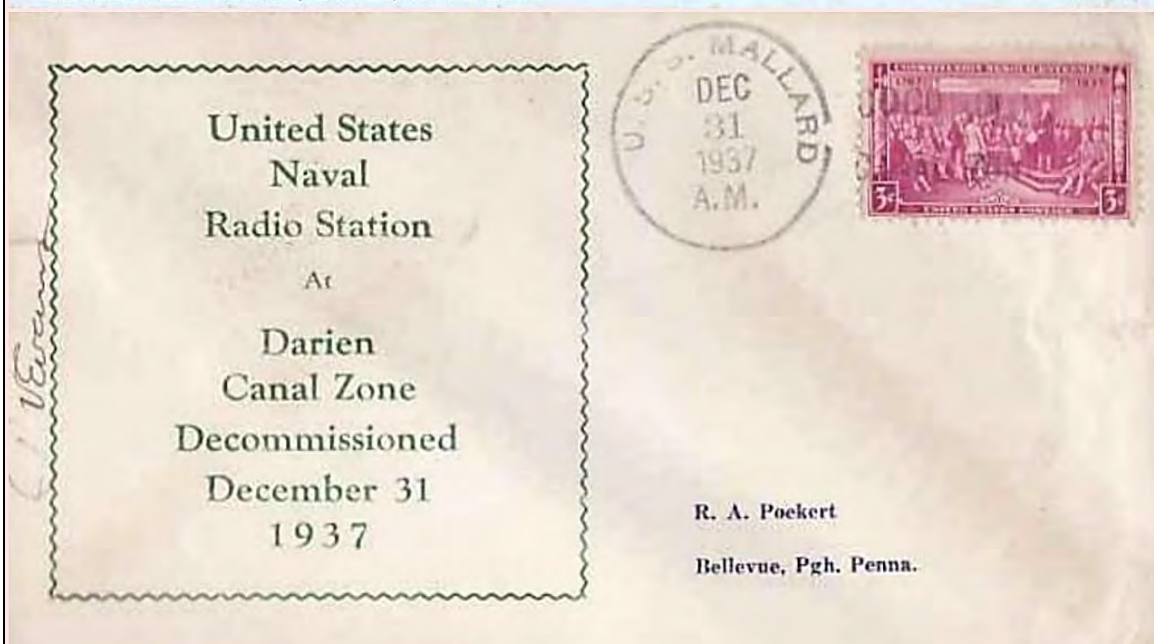


ESTACIÓN RADIOGRAFICA „DARIEN“ ZONA DEL CANAL.



DARIEN RADIO STATION, DARIEN, CANAL ZONE.

No. 521



Acknowledgment

Lorena Jethmal (Assistant Supervisor) and Manuel H. Barrelier D. (Civil Engineer), Vice Presidency of Infrastructure and Engineering.

Isaac Enrique Carranza, Xiomara E. Jaén Medianero, and Leopoldo De León; Office of Corporate Affairs.

Franklin Guardia, Environmental Protection Specialist, Vice Presidency of Water Resources Administration.



I. Introduction¹

In a world that is rapidly advancing, where new structures rise and technologies evolve, we often forget the rich tapestry of history woven into the very fabric of our environment. Abandoned historical heritage sites stand as silent witnesses to forgone eras, embodying stories, cultures, and architectures that have shaped our present. These sites, though neglected and forgotten, hold immense potential for restoration, preservation, and tourism promotion, offering a bridge between the past and the future.

RADIO DARIEN provided crucial support for naval operations in both the Atlantic and Pacific Oceans, acting as a backup to other primary communication facilities to ensure redundancy and reliability. The station was also instrumental in training military personnel in communication and signal operations, coordinating joint exercises, and strengthening the strategic presence of the US military in the Western Hemisphere. Its primary function was to facilitate long-range radio communication, ensuring reliable and secure channels between the US mainland, naval vessels, and other military installations in the Caribbean and Latin America.

Restoring the old Darien Radio Station is crucial for promoting historical and environmental tourism near Gamboa town along the Panama Canal. This landmark not only preserves cultural heritage but also enhances visitor experiences by showcasing the region's rich history and ecological significance. By revitalizing this site, we create educational opportunities and attract tourists interested in exploring the canal's impact on both local communities and global trade. Preserving this site allows us to celebrate its role in communication history while encouraging sustainable tourism practices that respect the environment and support local economies. It's a step towards conserving Panama's heritage for future generations.

This book is a journey into one of these abandoned historical treasures in the Panama Canal area. Honoring both United States and Panamanian heritage, the old U.S. Navy Darien Radio Station, operational from 1914 to 1935 stands as a testament to shared history and engineering ability. This historic site, near Gamboa along the Panama Canal, symbolizes collaborative efforts and cultural exchange, reflecting an era of industrial progress and cross-border cooperation.

¹ ChatGPT 3.5 - Chat Generative Pre-Trained Transformer - OpenAI.



“The Darien station is situated alongside the Canal at a point almost exactly midway between the Atlantic and the Pacific. Its erection was begun on July 9, 1914, and was completed the following May, although the handling of Government messages through the station had begun on April 5, 1915. The Darien station is, in general, like that at Arlington, Va., a 100-kilowatt plant with a normal sending radius of 3,000 miles. The aerials are carried on three 600-foot pyramidal towers, standing at the points of an equilateral triangle, 900 feet on the side. With its normal range the station can communicate to San Francisco, to a point 400 miles south of Valparaiso, to Buenos Aires, or to St. Vincent, about 500 miles west of the coast of Africa.”

The Panama Canal Record, Volume XV, October 5, 1921, page 131.

II. Location and Purpose²

Near the Panama Canal, a critical route for naval and commercial shipping. The station's primary purpose was to facilitate long-range communications for the U.S. Navy, providing a vital link between the Atlantic and Pacific fleets. It was part of a network of radio stations established to ensure secure and reliable naval communications.

Also known as NAVRADSTA Darien, its primary purpose was to serve as a strategic communication hub for the US Navy and other branches of the military. The station was part of a network of facilities that ensured reliable and secure communication channels for military operations, particularly during the Cold War era. Some specific purposes and functions of RADIO DARIEN:

Long-Range Communication: It facilitated long-range radio communication between the US mainland, naval vessels, and other military installations in the Caribbean and Latin America.

Monitoring and Intelligence: The station played a role in monitoring and gathering intelligence on military and political activities in the region, particularly those related to the Soviet Union and its allies.

Supporting Naval Operations: It provided communication support for naval operations in the Atlantic and Pacific Oceans, including the movement and coordination of fleets.

Backup Communication: As part of a broader network of communication stations, served as a backup to other primary communication facilities, ensuring redundancy and reliability.

Training and Coordination: The station was used for training military personnel in communication and signal operations, as well as coordinating joint exercises and operations with allied forces in the region.

² IBID

III. The Naval Radio Stations of the Panama Canal Zone³

In its system of radio communication for the Canal Zone, the navy has kept up to the high standard set by the Canal in general in having thoroughly modern equipment. The layout comprises one coastal station at each end of the Canal for ship to shore work, and one high-power station for long distance work.

In 1911, after several unsuccessful attempts by the representatives of the army and the naval interests to agree upon plans for the high-power radio station here, which was so important to the navy for its fleet communication, the matter was submitted to the joint Army and Navy Board. This board, whose report was approved by the President, recommended, among other things, that no private or commercial wireless installations be permitted in the Canal Zone; that the Navy Department have authority to install, maintain and operate under its jurisdiction a high-power wireless station in the Canal Zone, to be used in connection with its other stations in the Atlantic and Pacific, and for controlling the movements of its fleets in waters adjacent to the Panama Canal; and finally, that the wireless stations under the jurisdiction of the Navy Department shall be opened to the public service and shall transmit commercial business.

Darien Radio Station then was built as soon as the department had worked out the engineering features. Colon station had been built by the Navy Department in 1904. The department then built the Balboa station in 1913 to handle ships to shore work for the Pacific side. These three stations are thus linked in the department's comprehensive plan for radio communication with the fleet for purposes of national defense. As all other links of this chain are under naval administration it is necessary that these be likewise under that department.

The department has adopted the policy of making them indispensable to the Canal government both in its operating and military features, with the end in view that it may not be necessary to duplicate the stations with either government or commercial stations. In this way, besides automatically having control of radio already in the hands of the national defense on the opening of hostilities, there is always the least amount of interference possible, time is not wasted by dividing the hours with commercial neighboring stations, and important Messages may be given right of way.

³ By Lieutenant R. S. Crenshaw, U. S. Navy - July 1916.

The stations further will be manned at the opening of hostilities with the personnel familiar with the local conditions. The usual peace time means of communication being through these stations, the naval ships, transports or merchant auxiliary, at this time, will be thoroughly familiar with the stations as to wave lengths, radius of communication and land line connections. Further, all radio traffic connected with the operation of the Canal is handled in accordance with the governor's regulations and the facilities of the station have been offered to the governor, or his representatives, for Panama Canal or other official radio work.

Both Colon and Balboa stations handle commercial messages with ships and Colon handles messages with neighboring shore stations to which the cable service is unreliable. The low naval rate of six cents a word is charged here. Thus, the necessity for commercial stations is obviated. As is done at all naval radio stations, official messages for any departments of the government are handled free of station charge.

The Canal, as everyone knows, is here to handle shipping and to do it in the most expeditious way. Hence Article 40 of Executive Order giving the regulations for the operation of the Canal states that "as soon as radio communication can be established with the Canal, vessels should report their names, nationality, length, draft, tonnage, whether or not they desire to pass through the Canal, require coal, provisions, supplies, repairs, to go alongside of a wharf, the use of tugs, probable time of arrival, length of stay in port, or any other matters of importance or interest. If this information has been previously communicated, through agents or otherwise, to the captain of the port, it will not be necessary to report by radio, but the probable time of arrival should always be sent." Any radio messages relating to any of these subjects are regarded as Canal business and are handled without station charge, whether from the master of a ship or from the Canal authorities. Also, all ships are required to keep an operator on watch while making the passage of the Canal. This provision is to allow for transmitting rush orders relating to dispatching the ship through. There are now numerous visual signal stations along the route handled by telephone from the Marine Department, so that radio dispatching is only an emergency measure now. Before the visual signal stations were complete, however, four to six reports were received from each ship making the passage.

As a convenience to responsible steamship companies a monthly account is allowed for charges due on messages sent to their ships. Arrangements have been made with the Panama Canal whereby the bills for these messages may be paid by the Panama Canal from the company's deposit which has been put in the hands of the collector of the Canal, in advance, to cover all charges incurred in the passage of each ship.

During the construction days of the Canal the commission operated a quarry at Porto Bello, just 18 miles north of Colon on the coast. From here was obtained the rock for the building of the Gatun spillway and locks and for the breakwater in Colon harbor. To avoid the expense of installing and maintaining a telephone service there the Navy Department installed and operated a small radio outfit in a building owned by the Canal. Working with Colon this was used instead of telephonic communication for the commission's work.

The radio time service has been found to be of use here. The time signal now received on the Isthmus comes by the Central and South American cable over their line down the west coast. This signal is transferred to the cable from the land line at Galveston and passes through four cable relays before reaching Colon, where it is put on the Panama Railroad telegraph system through another relay. These relays are all automatic except the one at Panama, when the signal is forwarded by hand as the operator watches the syphon beat. In checking this time's signal against that received by radio from Key West, the writer has observed varying errors of from one to three seconds lag even over that from Key West, which itself has the lag due to the land line relays from Washington. The port captain at each terminal port has a chronometer for use of merchant skippers in comparing their chronometers. In his office is also brought an instrument from the Panama Railroad telegraph line over which the time signal is sent from Darien daily by hand as the operator hears the signal in his radio receiver. This crude method has proved to give better results than attempting to rate the chronometer by cable signal.

This system will be much improved upon the arrival of the up-to-date time transmitting installation which has been ordered for Darien radio station. It will consist of a transmitting clock, one of the same kinds ordered for the Naval Observatory at Washington. This clock will be set by electrically accelerating or retarding the period of the pendulum until the error is corrected. To set the clock, a local signal will be taken from the break of the main sending key of the radio transmitting set and brought into step with the time signal as being received by radio from Arlington. Darien will then transmit shortly after, before the clock has attained an error due to the rate it may have. A well rated break circuit chronometer will carry us over those schedules on which it may be impossible to set the clock by direct comparison. This time signal will probably be transmitted over the land wire for the railroad and made to operate a time ball at the terminal ports. With a bulletin giving the error each day, the installation is expected to be capable of giving a signal in Central and South America within the limits of accuracy suitable for astronomical work.

THE DARIEN RADIO STATION

The Darien Radio Station is located just 25 miles south of Colon on the Panama Railroad. The railroad forms the east boundary of the reservation which contains 872 acres. The southwest boundary is the Canal itself from which is a channel 20 feet deep and 75 feet wide into the center of the station plot. Those who may have visited the Canal before the water was allowed to rise may remember this site as being adjacent (to the southeastward) to the old town of San Pablo. On the "relocation" the nearest stop was Caimito Cabin at the north end of dumps. Thus, the site was known variously as the San Pablo or Caimito Radio, or simply as Radio in the early stages, until the department assigned the name Darien, when, by request, the governor named the railroad stop here Darien. Until the name was well known, our mail frequently went astray to the southernmost province of the Panama Republic which is known as the Darien section. This plot was decided upon with the following advantages in view. It was well out of gun range from either end, it was accessible to the railroad and Canal both, it was very close to the source of power (the trans-isthmian high tension line along the railroad), receiving tests showed the ground conditions to be good, and, finally, with the idea in mind of locating the towers on the hilltops and having an arm of the Gatun lake come in under the antenna between the towers, a good effective height could be obtained with moderately high towers.

Work started on construction in December 1913, by the Quartermaster Department of the Panama Canal. The site was far removed from any of the Canal Zone towns and was mostly jungle when the work started. A spur from the railroad was put in, laborers' barracks built and, as it is unsafe to unload cement in the open due to the sudden rains, a cement shed was erected close to the spur. With a hoisting engine on the hill all material was hauled up a narrow-gauge road in De Cauville dump cars. This narrow-gauge road continued around the station site for the delivery of material to the buildings and towers. The small locomotives, cars and tracks were relics of the French construction days. Water for the station was pumped to a tank on a hill by a Worthington pump which obtained its steam from the boiler of an old Belgian locomotive side-tracked for that purpose. Drinking water was distilled at this pump station. This equipment supplied the station until the arrival of the electric turbine pump. The Gatun lake water is now used and merely boiled for drinking and cooking purposes. The dwellings on the site are the house of the radio officer, cottage for the chief electrician in charge and barracks for the operators equipped to house 17 men. Servants' quarters are also provided in the barracks building. Rations are commuted at a dollar a day per man and a mess is run by the operators.

All the buildings are screened, including the porches. There is such a large breeding area for mosquitoes about the site that the cost would prohibit sufficient sanitation work to keep the mosquitoes down entirely. The means we have adopted are (1) keep the screening as tight as possible; (2) every morning a sanitary inspector makes the rounds catching the mosquitoes inside the living quarters and office; (3) no containers are allowed to collect water, in which they may be breeding, on the station site; (4) all drains are kept clear so no water stands in puddles; (5) around the edges of the water the bank is kept skinned to allow the small fish to eat the mosquito larvae (this means is remarkably effective); (6) the force of five laborers allowed the station is kept at work on the grounds- keeping the jungle growth cut down as well as possible. Then when one case of malaria did appear, in order to prevent an epidemic, the whole station crew was put on a quinine diet for 10 days.

The other buildings of the station are of concrete except the boathouse. This was built of old form lumber left over from the concrete work, and corrugated iron roofing robbed from old, abandoned shacks on the site, one of which was an old distillery. The transformer house contains only the main transformers (with oil switches and lightning arresters) where the 44,000 volts from the transmission line is stepped down to 440 volts.

The powerhouse is 60 feet by 30 feet and contains the motor generators for the main transmitting set, which uses 500 to 1200 volts direct current, and that for the auxiliaries using no volt's direct current. The main distributing and controlling switchboards are here, with the auxiliary transformers. Also, this building houses machine tools, a small lathe, drill press, milling machine and emery grinder and is fitted with a five ton overhead traveling crane.

The operating building contains the arc room (where is located the main transmitting set with its auxiliary electric controlling devices), the receiving room and the office, beside a spare room for an auxiliary sending set if needed later. The arc room and the receiving room both have wire mesh imbedded in their walls, floor and ceiling in order to prevent the induction from the transmitting set injuring the receivers. The building is fire-proof, necessary on account of the action of the continuous oscillations used at such high voltage. The charging current into iron in the vicinity of any live lead heats the iron quickly. Some of the reinforcing had to be taken out of one concrete base because the current jumped to it, and one wall 19 inches away from the end of the helix heats so that the hand cannot be borne on it after a 20-minute run. The reinforcement in this wall is merely metal lathing but is directly in the field of the main helix.

The towers for this station are of structural steel, triangular sections, self-supported. There are three 600 feet high each. As mentioned earlier in this article, it was the first intention to locate them on the tops of the hills, but on making the actual location it was found that the thrusts (which come on to the footings at the angle of slightly over 16 degrees from the vertical) would be too nearly parallel to the face of the hills to give solid backing for the footings. They were finally located so that all footings but one butt into the hills. In order to do this, however, the footings were put on about the 120-foot level instead of the 170-foot (the surface of Gatun lake being normally at the 85-foot level).

For each tower the feet form an equilateral triangle 150 feet on the side and taper upward to a triangle ten feet on a side at the top. When first erected there was considerable swaying in the bottom long diagonals, but these and others above were stiffened up by cross bracing so that now they are perfectly rigid. When the antenna was hoisted and adjusted to the sag which would give a pull of about 13,000 pounds, the top of each tower was pulled over only four inches during hoisting and settled back to two inches when hoisting stopped. All the bend was in the upper 200 feet.

The block for each footing is 16 feet deep and 20 feet square, heavily reinforced with old railroad rails. Each block filled entirely the hole excavated for it without back filling in order to have it bearing in solid earth. Each tower leg is insulated from the ground with heavy porcelain insulators. However, it has been found that greater radiation is obtained, and the arc "pulls" better with the towers grounded, so they are left grounded through a long knife switch. The distance between towers is: one and two, 897 feet; two and three, 751 feet; one and three, 969 feet, the antenna covering about six acres. The capacity, however, of this antenna is just the same as that of Arlington Got M. F.), though much larger in every way. Darien's capacity is evidently between the antenna and the ground, while Arlington's is between the antenna and the towers. The antenna was made at the New York Navy Yard and shipped to Darien, each wire on a separate reel and tagged to mark the points where any other wire crossed. The cables are all phosphor-bronze, the outside ones being 4-inch diameter, the four strain cables through the mat 3/8-inch diameter, and the 66 radiating wires of regular antenna wire. The first 150 feet of the down lead of 26 wires is a fan and then is grouped by spacing hoops to form the rattail. Each corner is insulated with the Arlington type of Locke insulators with, however, two strings in parallel, as the strain was too near the mechanical breaking limit of the insulators. Lightning has already struck the antenna twice without damage, due to the safety gap feature of these insulators and the towers being grounded. An electric winch on each tower furnishes the power needed for handling the antenna.

The Bureau of Steam Engineering generously provided the excellent machine tools mentioned above, and with the help of those and a chief machinist mate in the complement the station is practically self-sustaining, as it has to be, without the usual navy yard facilities. The variety of up-to-date equipment at this station provides a striking example of the wide field of electricity which the radio service opens to its electricians. The operators of Colon and Balboa stations are given tours of duty here to familiarize them with the special features.

Power for the station is taken from the Panama Canal transmission line. The current is 25 cycle A. C., three phase, supplied at 44,000 volts and stepped down in the substation through transformers to 440 volts. The transmission line is in duplicate and is fed from either the hydro-electric station at Gatun Spillway or from the Miraflores steam power plant. This duplication of lines and power plants both has given so reliable a service that no gas or oil engine has been put in as a stand-by source of power.

The high-tension A. C. equipment is up to date, the two lines being controlled by interlocked oil switches. In the system are also aluminum plate electrolytic lightning arresters to which the heavy switching or lightning surges jump through horn gaps on the roof of the substation. All of the motors in the powerhouse are 440 volts, but on account of the trouble with insulation in the very damp climate, those for use outside are of 220-volt type. To give the 220-volt current there are three single phase 440-220-volt transformers. Further, in order that supplies may be drawn from those standards in the Canal storehouses, all lighting was made 110 volts. This is obtained by stepping down a tap from one phase of the 440 volt current.

The motor generator sets for the main transmitter are duplicate. To provide for emergency drive a pulley has been provided which fits in the place of either motor. In this event, arrangements have been made to use a steam engine from some retired Panama Canal equipment, furnishing it with steam from a locomotive to be side-tracked here. The main set was furnished by the Federal Telegraph Company, and the arc generator is their type of the Poulsen arc. From 600 to 2000 volts are used across the arc. The set gives Arlington a signal easily readable except during the very worst static periods.

The arc can be controlled entirely from the operator's seat, the main generator voltage controlled there, circuit breakers closed or tripped, the arc struck and starting resistances short-circuited. While running, the arc is regulated to take up the wear of the carbon by foot pedals, so that the operator may not have to interrupt his sending.

The regular receiving cabinets with tikkers, as used by the Federal Telegraph Company, were provided with the outfit, but Dr. Austin's circuits with the oscillating audio are now used exclusively for long waves. For short wave work an oscillating audio detector is used on one of the Federal Company's cabinets.

While these are primarily military stations and are located to best suit the military needs, their peacetime activities are what we have to use for shaking them down. This is particularly true in the region of the Canal Zone, where the navy is so far away, and the stations do not get into the maneuvers. The traffic handled during the month of July (1915) was: Colon, 2299 messages; Balboa, 396; and Darien, 348. Colon handled over 800 commercial messages—over half with ships, the remainder with the United Fruit Company stations at Port Limon (Costa Rica), Bocas del Toro (Rep. de Panama) and Santa Marta (Colombia). Most of the United Fruit Company messages are in ten letter code words. This, with the messages in Spanish handled for the Panama Government, gives the operators at that station the best of practice. This is particularly true in that the bad static holds for eight or nine months of the year, and it is a fight for each letter when receiving through it. In justice to Darien, it may be said that most of its messages are long, and if reckoned by the number of words would make a much better showing. The traffic of this station is rapidly increasing, as the various departments of the government accept the offered services of the naval radio.

The Colon and Balboa stations use as their main sending set a five K. W. Lowenstein spark set. Each station also has a two K. W. auxiliary, and the Colon station has retained its big set for use with Key West in case of an interruption of the Darien-Arlington communication. Both Colon and Balboa stations have been rebuilt in the past 12 months. These stations are equipped with concrete power houses and operating buildings and the navy standard 300-foot steel towers. This, with the comfortable living quarters for the crew and the up-to-date radio equipment, places these stations among the best the navy has. All three of the radio stations are connected to the Panama Railroad telephone system through the local exchanges, Darien being on Colon and Balboa exchanges both. All government messages from Darien, or from the coastal stations which are in code, are delivered by telegraph, three lines of which come to each station. Commercial messages for other towns than the local town are forwarded by wire. This wire work requires the operators to become proficient in American Morse. Now that the Canal is open, it is hoped that the fleet may visit this vicinity more, in order that the operators here may do more navy work. They have daily excellent drilling in all features of radio, except the actual maneuvers with the fleet.

ANNUAL REPORT OF THE
ISTHMIAN CANAL
COMMISSION

FOR THE FISCAL YEAR ENDED JUNE 30

1913



WASHINGTON
1913

IV. Annual Report of the Isthmian Canal Commission (1913-1935)

1. For the Fiscal Year ended June 30, 1913:

Page 48: Surveys were made of the Miraflores Lake watershed, Corozal Hospital farm, Darien Radio Station reservation for the Navy Department, Chagres River from Gamboa to the Zone boundary to locate gravel banks, and the area in the vicinity of Mount Hope proposed for oil storage. The boundary line between the city of Panama and the Canal Zone was run out and monuments located. An error of 100 meters was found in the recorded distance between triangulation stations Gamboa and Obispo, the recorded distance being 1,093.34 and the correct distance 1,193.34 meters. Considerable survey work was also done for the department of law and the joint land commission.

2. For the Fiscal Year ended June 30, 1914:

Page 16: To supply power to the powerhouse of the Darien wireless station, being constructed by the Canal authorities for the Navy Department, arrangements have been made to install a small substation of 400-kilowatt capacity, tapping the transmission line and stepping the voltage down to 440 volts. A change in the location of the pumping plant from Miraflores to Gamboa has necessitated the installation of a substation at this location.

Page 23: As already noted, the division of municipal engineering was formed by consolidating the division of public works and the municipal work in the three construction divisions on July 16, 1913, and was placed in charge of Mr. George M. Wells as resident engineer. The division is divided into five principal sections: The northern district embraces all municipal construction, maintenance, and operation work, exclusive of the operation of filtration plants, from and including Colon to Darien, a distance of 25.27 miles; the southern district embraces similar work from Darien to Balboa, including the city of Panama, a distance of 22.34 miles; the waterworks for the southern end of The Panama Canal embraces the construction of the purification works at Miraflores, pumping stations at Gamboa, Miraflores, and Ancon, reservoirs, and the laying of new mains; the fourth subdivision embraces the operation and care of purification plants and the care and analyses of all Canal Zone water supplies; and the fifth subdivision embraces all work of design for the division.

Page 24: In addition to maintenance work in the southern district, a considerable amount of construction work was undertaken, including streets, water and sewer systems, and roads in the new silver town of La Boca, storm sewers in the gold town site of Balboa, water and sewer systems and streets at Pedro Miguel, the installation of water and sewer systems for the Darien radio station, and work in connection with an addition to the city of Panama, for which the Republic of Panama made a special appropriation of \$76,000.

Page 46: Radio station - In addition to the foregoing work, the building of the Darien radio station was placed in charge of this division [Terminals] and \$74,756.88 was spent during the year on its construction.

Page 48: While experience has shown that buildings can be moved faster and more economically when no alterations are made in the type, since the buildings being re-erected at Ancon will be used for the permanent force, it was concluded that some alterations should be made to afford greater comfort. Work in connection with the erection of buildings for the Darien radio station for the Navy was done by the supply department. The total amount expended for this work was \$53,314.72.

Page 100: DARIEN SUBSTATION.

To supply power to the powerhouse of Darien wireless station, arrangements have been made to install a small substation of 400-kilowatt capacity, tapping the transmission line and stepping the voltage down to 440 volts, three-phase, delta connected. Specifications for this equipment have been forwarded to the general purchasing officer.

Page 127: The division is charged with the maintenance within the limits of the Canal Zone of all roads, streets, sewers, water lines, and, since July 16, with air lines, and excepting within the limits of the new town of Balboa, with the construction of same; with the operation and maintenance of all pump stations and water-purification plants: the inspection of plumbing, with the construction and maintenance of sanitary ditches: and with the design and construction of the new waterworks and purification plants for the southern and northern end of The Panama Canal. It is also charged with the maintenance and construction of streets, roads, sewers, water lines; supervision and inspection of plumbing; and the collection of moneys from water rentals within the cities of Colon and Panama.

The division is divided into five principal subdivisions or sections, viz, northern district, southern district, waterworks for the southern end of The Panama Canal, filtration plants and water supplies, and designs.

The northern district, in charge of E. H. Chandler, superintendent, includes all municipal construction, maintenance, and operation work, exclusive of operation of filtration plants, from and including Colon to Darien.

The southern district, in charge of D. E. Wright, superintendent, embraces similar work from Darien to Balboa, including the city of Panama.

Page 130: In addition to the maintenance work, the division [Municipal Engineering] also had charge of considerable construction work in this district, including the building of the silver town site of La Boca; constructing the water and sewer systems and streets in Pedro Miguel and the concrete storm sewers in the gold town site of Balboa; the construction of the driveway in front of the Tivoli Hotel; the widening of the road leading to the hotel from Panama City; the installation of a water and sewer system for the Darien radio station; the installation of a permanent water-supply system for the Balboa shops; also, the completion of the Ancon-Diablo macadam road, which was commenced in the previous year; and the supervision of the work on the Empire-Gamboa macadam road, which is being built by the Canal Zone government with prison labor. This is in addition to the construction work performed during the year in the city of Panama.

Page 142: Instruments for recording wind velocity and direction were installed at the site of the Darien radio station on June 18, 1914. This installation was made at the request of the engineer in charge of terminal construction.

Page 192: Radio stations.

The Navy Department, in accordance with authority granted by the President of the United States in 1911 on the recommendation of the Secretary of War and the Secretary of the Navy, and with its funds provided by subsequent legislation, has authorized the construction of three radio stations in the Canal Zone.

The main or primary station for long-distance communication is located at Darien, along the Panama Railroad and adjacent to the shores of Gatun Lake, about midway between the Atlantic and Pacific Oceans. In addition, there will be two secondary stations, one located at Balboa dumps on the shores of the Pacific, about a mile from Balboa administration building, and one on the shores of the Atlantic in Colon, on the site of the radio station that has been maintained by the Navy Department for the last eight years. The principal duty of these two secondary stations will be to transmit messages to and from vessels in the adjacent canal waters, and within a radius of about 300 miles from the canal.

All these stations are intended to transact canal and commercial as well as naval business. The construction of these stations, except the operating equipment, is under the jurisdiction of the Bureau of Yards and Docks of the Navy Department, and, at the request of the bureau, Civil Engineer F. H. Cooke, United States Navy, has been detailed, in addition to his other duties, as inspector on the Isthmus of all work in connection with these stations under the Bureau of Yards and Docks. Supervisor Ira W. Dye has acted as his principal assistant on this work since March 11, 1914. The Bureau of Steam Engineering has jurisdiction over the purchase and installation of the operating equipment, which work is to be performed under the supervision of the naval radio officer on the Isthmus, Lieut. R. S. Crenshaw, United States Navy.

The aerial of the Darien station will be attached to the tops of three self-supporting steel towers, each 600 feet in height above the foundations. The aerials of the Colon and Balboa stations will be attached to the tops of two self-supporting steel towers, each 300 feet in height above foundations. The contract for the steel towers at Darien station was awarded by the Navy Department to the Penn Bridge Co., of Beaver Falls, Pa., for the fabrication and erection of the three towers. The contract is dated June 26, 1913, and the price is \$112,350. The three towers weigh about 980 tons. The contract for the four 300-foot towers, required for the Colon and Balboa stations, was awarded, on May 18, 1914, to A. W. Kurz, of New York City, for \$19,955. These four towers weigh about 200 tons. The first shipment of structural steel for the Darien towers was delivered to the site early in June 1914. No steel had been erected by the subcontractor at the end of the fiscal year. No steelwork for the Colon and Balboa towers had been delivered up to the end of the fiscal year.

The contract for the power plant and radio equipment for the Darien station was awarded by the Navy Department to the Federal Telegraph Co., of San Francisco. The contract is dated June 30, 1913, and amounts to \$52,691.33. It is understood that the Navy Department does not intend to purchase any new radio equipment for the Colon and Balboa stations, but to utilize equipment at present in use on the Isthmus for practically the entire installation for both stations.

The work performed on the Isthmus during the year at each station includes the design and installation of the foundations for the towers, the construction of buildings, the installation of water system, sewer system, roads and walks, grading, clearing of ground, etc. The work has been performed by the various departments and divisions of The Panama Canal as follows:

The supply department has built the foundations and buildings and has done considerable clearing.

The division of municipal engineering has installed the water supply and sewer systems and constructed roads at the secondary stations.

The electrical division has performed services and work connected with the electrical installations.

The fortifications division has done some clearing, and the general construction division and the Panama Railroad have done some grading.

Surveys and field engineering were carried out by the section of general surveys of the department of operation and maintenance.

At each of the three stations buildings are required for housing the power-generating and the transmitting and receiving apparatus, as well as living quarters for the operating forces. At Darien these buildings comprise operating building, powerhouse, substation for stepping down the high potential voltage carried by the trans-Isthmian transmission line, operators' barracks, quarters for the officer in charge and chief electrician, and a storehouse. At Colon and Balboa, the buildings comprise operating buildings, powerhouse, operators' barracks, and one set of double quarters for the chief electricians. At Balboa there is, in addition, a storehouse. In each case the quarters are of frame construction and the remainder of the buildings of concrete. The preparation of plans, issuance of construction directions, and general supervision of the construction work has been performed by the division of terminal construction.

At the close of the fiscal year the tower foundations were completed at each of the three stations, as was the greater part of the building and municipal work at the Darien station. At the Colon and Balboa stations the buildings, water supply, and sewerage installations were well advanced, considering the date on which the construction of these stations was authorized by the Navy Department.

Page 192: One gang, under Foreman Galliher, has been handling the work at the Darien radio station for the Navy throughout the year. Originally 3 buildings, at a cost of \$20,000, were to be constructed by this department for the Navy Department. The supply department has constructed, beside these buildings, the foundations for the towers, removed and re-erected houses for the officer in charge, for the chief electrician, and has done various other jobs. The total cost of this work to June 30, 1914, has been \$53,314.72.

EXHIBIT 9.—*Number of buildings on the Canal Zone June 30, 1914.*

	Panama Canal.	French.	Panama R. R.	Private.	Total.
Alhajuela.....	2	2			4
Ancon.....	259	38	2		299
Balboa.....	270	1	6		277
Bas Obispo.....	58	92	4		154
Camp "E. S. Otis".....	23	36		9	68
Colon Beach.....			45		45
Colon Hospital.....	37	10			47
Corozal.....	123	32			155
Cristobal.....	170	93	52		315
Cruces.....	1				1
Culebra.....	151	40		1	192
Culebra Island.....	9				9
Darien.....				6	6
Empire.....	160	100		2	262
Flamenco Island.....	3				3
Gatun.....	180		4	1	185
Las Cascadas.....	70	51			121
Las Sabanas.....	2				2
Marguerita Island.....	7				7
Miraflores.....	2	5			7
Monte Lirio.....	1		3		4
Naos Island.....	7				7
New Frijoles.....	2	2	1		5
Palo Seco.....	16				16
Panama.....	1	1			2
Paraiso.....	100	49			149
Pedro Miguel.....	79	11			90
Porto Bello.....	43				43
Taboga Island.....	5	4			9
Toro Point.....	50				50
Vigia.....	1				1
Total.....	1,832	567	117	19	2,535

EXHIBIT 10.—*New frame construction, fiscal year 1913-14.*

Department or division.	New structures.		Additions.		Total.	
	Number.	Cost.	Number.	Cost.	Number.	Cost.
Quartermaster's department and general use.....	5	\$15,807.10	1	\$1,187.50	6	\$16,994.60
First division.....	8	6,510.39			8	6,510.39
Second division.....	2	2,510.55			2	2,510.55
Dredging division.....	2	1,771.38			2	1,771.38
Commissary department.....	1	2,422.48	2	3,728.00	3	6,150.48
Subsistence department.....	1	726.06	2	1,515.11	3	2,241.17
Division of clubs.....			1	46.10	1	46.10
Canal Zone government.....			1	3,179.68	1	3,179.68
Terminals.....			1	1,036.26	1	1,036.26
Municipal engineering.....	1	997.34			1	997.34
Sanitary department.....	2	378.96			2	378.96
Total.....	22	31,124.26	8	10,692.65	30	41,816.91
Pedro Miguel commissary, account No. 401.....	1	8,612.22			1	8,612.22
Grand total.....	23	39,736.48	8	10,692.65	31	50,429.13

Page 311: REPORT OF THE RESIDENT ENGINEER, PERMANENT BUILDING DIVISION, SUPPLY DEPARTMENT, SEPT. 13 [1913] TO JUNE 30, 1914:

... As the work progressed it was divided into two districts. Mr. Frank J. Carew was appointed superintendent of the northern district and began work on August 26, 1913. He was later transferred to the southern district on March 1, 1914, and Mr. Hugh P. Oram was appointed and given charge of the northern district on that date.

Effective December 1, 1913, the permanent building work and the work of re-erection and maintenance of buildings were consolidated, and Mr. Charles B. Cook, formerly in charge of re-erection, was appointed as assistant to the resident engineer.

Buildings under construction on June 30, 1914:

Northern district:

Hydroelectric station, Gatun.

Two transmission line substations, Cristobal and Gatun.

Commissary warehouse, Cristobal:

Radio station buildings, Colon and Darien.

Southern district:

Administration building, Balboa.

Two transmission line substations, Miraflores and Balboa.

Permanent quarters, Balboa (twenty-eight 4-family and nine 2-family quarters).

Shops office, building No. 28, Balboa.

Fire station, Balboa.

Commissary building, Balboa.

Schoolhouse, Balboa.

Radio station, Balboa.

Commissary building, Ancon.

Page 311: RADIO STATIONS.

Under work request from the Navy Department, through the division of terminal construction, the necessary buildings for radio stations and foundations for radio towers are under construction at Colon, Darien, and Balboa.

DARIEN RADIO STATION. The work at the Darien radio station consists of 9 concrete anchorage foundations, 3 for each of three 600-foot steel towers, each foundation being 16 by 20 by 15 feet, and containing the anchorage for the tower leg which rests upon it. The base of each tower covers an equilateral triangle with sides 150 feet in length, and the three towers are arranged in a triangle, the sides of which are as follows: 970 by 896 by 752 feet.

Page 416: Fire protection was provided for the new piers Nos. 8 and 9 at Cristobal. This included a 6-inch water main on the piers, with ample supply mains and standpipes. Twenty-four hundred feet of hose were installed in racks beside the standpipes, and 3 fire-alarm boxes provided. New installations of fire hose, fire extinguisher, nozzles, etc., were made at the Balboa shops and at Gamboa, Darien, Coco Solo, and Mindi Island. Ramps for loading and unloading the automobile fire engines on flat cars were constructed at Balboa and at Cristobal.

Page 514: The radio stations located in the Canal Zone have been placed under the jurisdiction of the Navy Department, and pursuant to that order a site was set apart for the radio station at Balboa dump, to be known as Balboa Station, by Executive order of May 26, 1914. An Executive order has also been drafted, but not yet promulgated, setting apart the site near Caimito, to be known as the Darien Station.

3. For the Fiscal Year ended June 30, 1915:

Page 4: A substation was constructed at Gamboa for the new pumping plant of the municipal division, the sand and gravel handling plant of the Panama Railroad Company, and for local lighting. It was placed in service during February 1915, and contains two transformers of 666 KVA capacity each, with the necessary oil switches, lightning arresters, etc. A substation was also constructed and placed in operation in March 1915, for the Darien High Power Naval Radio Station. It contains two 266 KVA transformers and auxiliaries. This work was paid for by the Navy Department.

Page 5: Municipal engineering. The division of municipal engineering was in charge of Mr. George M. Wells, as resident engineer, until May 10, when, due to the practical completion of the Panama waterworks, he was assigned to other duties and

the work of the division was transferred to Mr. D. E. Wright, as municipal engineer. The division is divided into two districts, the northern district covering that part of the Canal Zone lying north of Darien, including the city of Colon, and the southern district embracing the Canal Zone lying south of Darien, including the city of Panama.

Page 74: Two small substations, one at Gamboa of 1,332 KVA transformer capacity for the supply of power to the pumping and gravel handling plants at that place, and one at Darien of 532 KVA transformer capacity for the naval radio station were constructed and placed in operation during the year.

Page 80: A substation at Darien for the high-power naval radio station at that place was constructed during the year and placed in operation in March 1915. It contains two 266 KVA. transformers and auxiliaries. Its cost was \$12,772.08, exclusive of building. The cost of the building cannot be given as it was not segregated from other building work performed for the Navy Department at the Darien radio station.

Page 81: The four permanent central offices are located at Balboa Heights, Pedro Miguel, Gatun, and Cristobal with a secondary central at Empire and PBX boards at the Governor's office, Naos Island, Hotel Tivoli, Ancon Hospital, Paraiso, and Coco Solo. Trunk service is furnished for outside switchboards at Toro Point, Hotel Washington, Camp Otis, Darien radio station, Balboa radio station. Colon radio station, Gatun Locks, Pedro Miguel Locks, Miraflores Locks, and the United Fruit Co.'s office in Cristobal.

Page 84: Radio station.

The electrical work in connection with the construction of the Darien substation and the installation of switchboards, underground and overhead distribution systems, house-lighting systems, etc., for the radio stations at Colon, Darien, and Balboa was done for the Navy Department during the fiscal year.

Page 84: United States Army: Headquarters building, Fort Grant; commanding officer's quarters, Fort Grant; 2 major's quarters, Fort Grant; 6 two-family captain's quarters. Fort Grant; 4 four-family lieutenants' quarters. Fort Grant; 5 four-family noncommissioned officers' quarters. Fort Grant; 8 one-company barracks buildings, Fort Grant; storehouse, Naoa Island. United States Navy: Substation, Darien; radio stations, Darien, Balboa, Colon (7 buildings). In addition to the work listed above in concrete buildings, similar work was performed in 134 frame buildings that have been constructed, remodeled, or taken down and re-erected in the last fiscal year.

REPORT OF THE ENGINEER OF MAINTENANCE.

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	Ancon-Balboa.	Pedro Miguel.	Gatun.	Cristobal.
Engineering and surveys.....	\$56.56	\$1.98	\$10.00	\$17.86
Cables and transformers.....	14,947.84	180.45	1,733.46	2,615.99
Posts, globes, and lamps.....	7,645.98	577.20	1,623.34	1,262.16
Miscellaneous.....				45.00
Division expense.....	1,017.94	24.38	149.06	135.43
Total.....	23,668.32	684.01	3,515.86	4,076.44

¹ Charges not completed on June 30, 1915.

Underground conduit and distribution systems.—A large amount of construction work has been done in connection with the installation of underground conduit and electrical distribution systems for light, power, telephone, telegraph, and fire-alarm service in the permanent towns and for the supply of coaling plants, dry docks, pumping stations, Army posts, etc. This work has involved the construction of 39,675 linear feet of conduit line containing from 2 to 16 ducts, 139 concrete manholes, 10 concrete transformer houses, 98 handholes, and the installation of 171,400 feet of primary and secondary light and power cable, and 30 transformers. The following tabulations show details of this work:

Details of construction work on underground conduit and distribution systems.

District.	Installed.												
	2-way conduit.	4-way conduit.	6-way conduit.	8-way conduit.	12-way conduit.	16-way conduit.	Transformer manholes.	Cable-pull manholes.	Handholes.	Transformer houses.	Primary cable.	Secondary cable.	Transformer.
Ancon-Balboa-Corozal.	Lin. ft.	Lin. ft.	Lin. ft.	Lin. ft.	Lin. ft.	Lin. ft.					Lin. ft.	Lin. ft.	
Fort Grant.	1,288	5,785	2,268	5,491	2,026	2,184	20	41	76	2	67,340	30,880	23
Pedro Miguel.		3,843		3,146			10	16	22		3,723	7,668	5
Gatun.		827					1	2			1,800		
		1,739		569			8	9			8,681	2,855	
Cristobal-Colon.		13,450	1,430	920		1,305	2	3		8	36,530	8,500	2
				15,434			2	25					
Darien radio								2				3,425	
Total.	1,288	15,644	2,698	15,560	2,026	2,489	41	98	98	10	118,074	53,328	30

¹ Work done by Panama Railroad for electrical division.*Details of construction costs on underground conduit and distribution systems.*

District.	Engineering and surveys.	Excavation and back fill.	Duct material, placing and encasement.	Manholes and pull-holes.	Cables and transformers, material and installation.	Miscellaneous.	General expense (division overhead).	Total.
Ancon-Balboa-Corozal.....	\$1,286.50	\$11,452.35	\$32,556.60	\$8,227.58	\$48,881.65	\$2,446.71	\$6,956.71	\$111,808.10
Fort Grant.....								6,657.20
Pedro Miguel.....	29.78	341.04	438.22	178.37	2,121.63		113.33	3,222.37
Gatun.....	63.22	1,076.37	1,739.75	539.57	5,428.92	441.57	885.06	10,174.46
Cristobal-Colon.....	327.89	670.60	1,518.04	637.04	27,754.57	145.20	1,192.70	32,573.63
Total.....								118,546.21

¹ Covers cost of work done for electrical division by Panama Railroad. Charges were not classified.

Page 86: The northern district covers that part of the Canal Zone lying north of Darien and includes the city of Colon, and all the municipal work in this district with the exception of the operation of the water purification plants is in charge of Superintendent E. H. Chandler, reporting direct to the municipal engineer.

During the year the usual maintenance and repair work was performed on the water and sewer systems and on the roads and streets in this district.

In connection with the maintenance work on the water and sewer systems, a monthly inspection and test of all fire hydrants and valves was made and the sewer systems were flushed at frequent intervals.

No extensive repairs were made to the roads during the year, but the roads and streets were maintained and kept in good condition and were resurfaced as this became necessary in certain sections.

The two reservoirs in this district were maintained, each being in charge of a custodian who has authority of a police officer for the purpose of preventing trespassing on the water shed of the reservoirs. In addition to the usual duties of the position, the custodians kept daily records of the rainfall at their respective stations and reported the same to the Meteorological section.

Page 89: The report of operations of all pumping stations in the southern district is as given by the following statement:

Station.	Average number of gallons pumped per month.	During the period—
Ancon.....	19,056,722	July 1, 1914, to Mar. 16, 1915.
Miraflores temporary station.....	136,221,468	Do.
Cucaracha (Tanks).....	5,423,166	July 1, 1914, to June 30, 1915.
Cucaracha (Mount Zion).....	4,498,265	Do.
Comacho.....	2,928,916	Do.
Gamboa.....	32,528,142	July 1, 1914, to Feb. 1, 1915.
Paraiso.....	4,199,230	July 1, 1914, to June 30, 1915.
Caimito.....	160,000	Oct. 1, 1914, to June 30, 1915.
Station No. 1, Gamboa.....	236,815,000	Mar. 1, 1915, to June 30, 1915.
Station No. 2, Miraflores.....	23,993,000	Do.
Darien station.....	150,000	June 1, 1915, to June 30, 1915.

In accordance with the terms of an official circular of the Governor, the care and maintenance and operation of all water distribution and water-supply systems on the Zone was transferred to the municipal division on September 1, 1914. This included the water-supply systems of the Panama Railroad Company at Monte Lirio and at

Frijoles and certain other water-distribution systems of the Panama Railroad and of other divisions of The Panama Canal. By this same circular rate were established for the sale of fresh water to steamers and the municipal division was given charge of the sale of this water over the docks.

Page 119: Section of Office Engineer. C. J. Embree, office engineer.

On September 21, 1914, the section of office engineer was reorganized, centralizing the drafting forces of lock operation and maintenance, electrical division, municipal engineering division, division of terminal construction (including permanent shops, coaling plants, dry docks, oil terminals, and wharves) and the building division.

The drafting force has been assigned to the various assistant engineers in direct charge of the design work, except for work on lock operation and maintenance, which is in direct charge of the office engineer, who has also prepared requisitions and specifications for the electrical equipment of Gamboa and Darien substations, regulating valves and machines, towing locomotives, track turnouts, and all other equipment which has been required during the fiscal year for the operation and maintenance of the locks.

The blue-print room maintained in connection with the drafting room has produced a total of 522,691 square feet of blue, white, brown, and cloth prints.

Respectfully, Chester Harding, Engineer of Maintenance.

Maj. Gen. Geo. W. Goethals, United States Army, Governor, The Panama Canal, Balboa Heights, Canal Zone.

Page 131: RADIO STATIONS.

The last annual report described the general features of the three radio stations, Darien, Colon, and Balboa, which are being constructed on the Isthmus for the Navy Department.

Civil Engineer F. H. Cooke, United States Navy, continued to perform the duties of inspector in charge for the Bureau of Yards and Docks of the Navy Department during the year. The inspection work was under the immediate direction of Supervisor Ira W. Dye and a force of sub inspectors. Mr. Dye resigned effective May 7, 1915.

At the Darien radio station, the contractor for the three 600-foot self-supporting steel towers completed the original contract March 30, 1915. This contract is numbered 1948A, between the Navy Department and the Penn Bridge Co., of

Beaver Falls, Pa. The original contract price was \$112,350, and the total payment to the contractor was \$135,455.26. Of the increase over the original contract price, \$10,626.96 was for modifications and additions to the tower structures. The work has been accepted and final payment has been made.

During the fiscal year, forces of the building, municipal, and electrical divisions of The Panama Canal completed the buildings, water supply, sewerage, electric installation, and improvement of grounds, as well as the foundations for the towers. The buildings include transformer house, powerhouse, operating building, operators' barracks, quarters for officer in charge and chief electrician, and a storehouse. The permanent water supply is drawn from Gatun Lake by an electrically driven pump which discharges into a system of piping connected with two storage tanks on a near-by elevation. The necessary hydrants are provided for fire protection. The power supply is 3-phase alternating current at 44,000 volts, which is stepped down to the working voltage within the station.

The radio apparatus and power generating and transforming equipment in the powerhouse were furnished by the Federal Telegraph Co. of San Francisco, Cal. At the close of the fiscal year all of the original construction work had been completed, except a few minor details, and the station was in operation.

At the Colon and Balboa stations the contractor for the two 300-foot self-supporting steel towers at each station completed his work May 12, 1915, for Colon, and May 20, 1915, for Balboa. The contract is No. 2047, between the Navy Department and A. W. Kurz, New York, N. Y., the contract price being \$19,955.

The tower foundations, buildings, sewer and water and power installations at each station have been executed by the forces of The Panama Canal and the Panama Railroad. At each station there is a powerhouse, an operating building, operators' barracks, and one set of double quarters for chief electricians. At the close of the fiscal year all original construction had been completed except for a few minor details.

On November 9, 1914, the old north wooden mast at the Colon radio station fell while being taken down by contract, resulting in the death of two of the contractor's employees who were on the mast at the time.

Page 456: An Executive order of a purely administrative nature was issued by the President on July 30, 1914, setting aside a certain area of land in the Canal Zone for the purposes of the Darien Naval Radio Station. It was the desire of the Navy Department to obtain jurisdiction over this area, but, inasmuch as all civil and

political jurisdiction in the Canal Zone is vested in the Governor by the Panama Canal Act, the request of the Navy Department could not be complied with, though the area in question has been turned over to that department for all administrative purposes connected with the operation of the wireless station.

4. For the Fiscal Year ended June 30, 1916:

Page 97: The operation of the 44,000-volt transmission lines has also been satisfactory during the year. On the aggregate length of approximately 90 miles of high-voltage lines there have been a total of 33 interruptions of service, 19 of which were caused by insulator failures, one to failure of bushing of current transformer at Darien substation, one to failure of hydroelectric station feeder cable, one to a locomotive crane fouling the line, one to an animal attempting to crawl over a strain insulator, and 10 to unknown causes, probably insulator flashing over. The distribution of the insulator failures, by months, was as follows: January, February, March, May, June, and July, each one failure; April, August, October, and December, each two failures; September five failures and November none.

Page 206: PRECISE LEVEL BENCHMARKS. P. B. M. datum versus Gatun Lake level. A series of readings were taken in March from the P. B. M. datum onto the Gatun Lake level at Pedro Miguel, Gamboa, Darien, Frijoles, and Gatun. The readings were highest at Darien, as in the readings of the previous year.

Page 230: RADIO STATIONS. The 1915 report stated that the radio stations at Darien, Colon, and Balboa were practically completed during that fiscal year. The few outstanding matters, such as cleaning up and the completion of the subsequently authorized operating platforms on the towers, were finished early in the fiscal year 1916, and the inspection force was disbanded on August 30, 1915.

Page 281: Under the classification "Army work" are included all buildings listed in the two appropriations known as the \$700,000 and \$1,290,000 appropriations, and also such additional new buildings as were authorized from time to time by special orders of the Secretary of War. The buildings authorized under the \$700,000 appropriation having been practically completed by the close of the fiscal year 1915, work during the past year was confined to buildings carried in the \$1,290,000 appropriation.

The following tables give all principal buildings costing more than \$1,000 that were in course of construction at the beginning of the fiscal year, and all buildings authorized during the year on which construction was commenced and completed or partially completed.

REPORT OF RESIDENT ENGINEER, BUILDING DIVISION. 283

CANAL AND PANAMA RAILROAD BUILDINGS—Continued.

Item.	Name of building.	Number of buildings.	Type.	Date completed.	Cost.
<i>Buildings commenced during year—Continued.</i>					
57	Motor-bus repair shop.....	1	do.....	5 per cent.....	
58	Bowling alleys, La Boca Y. M. C. A. clubhouse.	1	Concrete.....	1 per cent.....	
	Total.....	68			\$768,021.15

Total number canal and Panama R. R. buildings completed or partially completed during year, 123.
Total cost of completed buildings, \$1,416,867.10.

ARMY BUILDINGS.

Item.	Name of building.	Number of buildings.	Type.	Date completed.	Cost.
<i>Under construction July 1, 1915.</i>					
59	Field office quarters.....	2	Concrete and terra cotta.	September, 1915.	\$27,845.90
60	4-family lieutenant's quarters.....	2	do.....	do.....	40,764.55
61	2-family captains' quarters.....	3	do.....	do.....	44,415.73
62	Noncommissioned officers' quarters.....	3	do.....	August, 1915.....	36,608.40
63	Barracks.....	4	Concrete and frame floors.	September, 1915.	131,517.39
64	Engineer company stables.....	1	Concrete and frame.....	July, 1915.....	5,932.31
65	Wagon shed, Engineer company.	1	Frame.....	do.....	1,473.62
66	Signal company stables.....	3	Concrete and frame.....	do.....	7,871.94
67	Signal company wagon shed.....	1	Frame.....	do.....	1,406.41
68	Stables, ambulance company.	3	Concrete and frame.....	do.....	8,417.30
69	Wagon sheds, ambulance company.	1	Frame.....	do.....	2,023.09
70	Stables, Cavalry.....	3	Concrete and frame.....	November, 1915.	40,313.29
71	Equipment buildings, Cavalry.	3	Frame.....	do.....	12,240.07
72	Stable, Artillery.....	4	Concrete and frame.....	December, 1915.	47,653.24
73	Equipment buildings.....	4	Frame.....	September, 1915.	9,351.49
74	Double mess building.....	1	do.....	August, 1915.....	3,146.59
75	1-family cottage.....	3	Type 17, old cls., frame..	July, 1915.....	5,054.29
76	200,000-gallon water tank.....	1	Concrete.....	August, 1915.....	5,096.10
	Total.....	43			431,131.71
<i>Buildings commenced during year.</i>					
77	Pump station and sump.....	1	Concrete.....	November, 1915.	5,760.81
78	Lieutenants' quarters.....	6	Type E/2, 1-family frame	December, 1915.	27,830.41
79	Captains' quarters.....	3	Type 20, 1-family frame.	January, 1916.....	18,131.51
80	Storehouse, Amador.....	1	Concrete, terra cotta.....	October, 1915.....	26,715.60
81	Storehouse, Naos.....	1	do.....	January, 1916.....	21,844.30
82	Staff quarters.....	5	Type 8, frame, slate roofs.	November, 1915.	39,945.19
83	do.....	1	Type 21, frame.....	do.....	6,058.26
84	do.....	1	Type 20, frame.....	October, 1915.....	7,073.49
85	Lieutenants' quarters.....	2	Type E/2, frame.....	December, 1915.	8,506.49
86	Commanding officer's quarters.	1	Type 3, frame.....	February, 1916.	7,570.87
87	Headquarters building.....	1	Frame.....	March, 1916.....	30,800.70
88	Barracks, Quartermaster company.	2	do.....	do.....	49,900.45
89	Noncommissioned officers'.....	2	Type 14, revised frame..	February, 1916..	15,653.89
90	Stable and wagon shed.....	2	Concrete and frame.....	November, 1915.	5,184.06
91	Storehouse.....	1	Concrete.....	March, 1916.....	31,674.31
92	Staff quarters.....	2	Type 20, frame.....	January, 1916.....	14,616.89
93	do.....	1	Type 21, frame.....	do.....	5,759.75
94	Quarters, colored employees, Navy, Darien.	1	Frame.....	November, 1915.	2,279.86
95	Dock, Margarita.....	1	Timber.....	May, 1916.....	14,616.76
96	Storehouse.....	1	Concrete and frame.....	do.....	17,911.45
97	Incinerator.....	1	Concrete and brick.....	June, 1916.....	7,644.62
98	Barracks, Artillery.....	1	Frame.....	March, 1916.....	10,505.31
99	Storehouse, Engineers.....	1	Concrete.....	May, 1916.....	4,838.63
100	Stable and wagon shed.....	2	Concrete and frame.....	April, 1916.....	3,405.62
101	Storehouse, signal.....	1	do.....	do.....	1,355.40
102	Storehouse, ordnance.....	1	Frame.....	do.....	6,045.91
	Total.....	43			391,633.54

Total number Army buildings completed or partially completed during year, 86.
Total cost of completed buildings, \$822,765.25.

TABLE NO. 59.—Summary of a house-to-house canvass of the population of the Canal Zone, taken between June 1 and 10, 1916, by the police and fire division.

BALBOA DISTRICT.

Location.	Americans.		All others.		Americans.		All others.		Total.
	Men.	Em- ployees.	Men.	Em- ployees.	Women.	Chil- dren.	Women.	Chil- dren.	
Ancon.....	903	903	170	170	385	363	54	3	1,878
Ancon Hospital:									
Doctors.....	21	21							21
Nurses.....	5	5			66				71
Patients (except soldiers).....	38	33	260	160	27	5	61		391
Attendants.....	19	19	87	87			10		116
Tivoli Hotel.....	46	6	44	44	11	4	2		107
Pueblo Nuevo.....			48	22			60	49	157
Naos Island.....	10	10	46	46					56
Culebra Island.....									
Palo Seco.....	1	1	14	14	1		5		21
Patients, Palo Seco.....			32				18	12	62
Balboa, Balboa Heights, and La Boca.....	937	928	1,616	1,604	342	322	726	715	4,658
Quarantine Station..	4	4	16	16	3	1			24
Balboa Harbor.....	3	3	6	6					9
Rural District.....			3				6	10	19
Corozal.....	28	28	111	111	15	6	17	12	189
Asylum.....	2	3			4	4			11
Doctors.....	3	3							3
Nurses.....	4	4			4				8
Patients.....	5		161				116		282
Attendants.....			25	25			12		37
Rural District.....			22	5			16	13	51
Pedro Miguel.....	233	233	80	80	122	144	59	53	691
Labor camps.....			206	206					206
Rural District, east and west of Canal prism.....			6				2	4	12
Red tank.....			76	76			75	91	242
Miraflores.....	28	28	47	47			24	31	130
Paraiso.....	320	320	227	213	79	90	183	230	1,129
Jamaica Town.....			204	182			136	127	467
Spanish Town.....			93	60			46	32	171
Floating equipment..	84	84	420	420					504
Labor camps.....			471	471					471
Rural, from Paraiso to Gamboa.....	4	4	102	99	1	1	12	19	139
Culebra.....	9	5	3	3	5	4	24	3	48
Rio Grande.....			74	74			60	70	204
Enterprise.....			103	103			41	55	199
West Culebra.....									
Golden Green.....			109	17			113	92	314
Empire.....	8	8	126	18	6	4	97	112	353
Lirio Camp.....			99	98			68	92	259
Cerro Camp.....			69	63			71	103	243
Cunette.....									
Martinique Camp.....	1	1	74	21	1	2	66	61	205
Bas Obispo.....			40	40			22	19	81
Gamboa Stockade.....	7	7	8	8					15
Total employees.....		2,661		4,609					
Total persons.....	2,724		5,298		1,072	950	2,202	2,008	14,254

CRISTOBAL DISTRICT.

Gamboa.....	25	24	88	88	6	4	20	21	164
Floating equipment..	8	8	83	83					91
Darien.....			5	5			8	3	21
Frijoles.....	2	2	43	39	1		13	17	76
Monte Lirio.....	3	3	43	31	2	1	27	31	107
Gatun.....	223	219			180	222			625
Labor camps.....			238	238			120	210	568
New Gatun.....			1,088	878			742	704	2,534
Boca Mindi.....			2	2					2
Puerto Escondido..			6	6					6
Marajual.....	1	1	44	43			4	3	52
Mount Hope.....	15	15	84	75	11	20	12	24	166
Cristobal.....	658	658	28	28	195	295			1,176
Folks River.....	16	7	351	314	10	8	234	317	966
Camp Biedr.....			1,683	1,683			37	98	1,818
Bracho.....			17	17					17
Toro Point.....			4	4			6	1	11
Total employees.....		937		3,534					
Total persons.....	951		3,807		405	550	1,223	1,459	8,395

TABLE No. 59. —Summary of a house-to-house canvass of the population of the Canal Zone, taken between June 1 and 10, 1916, by the police and fire division—Continued.

GATUN LAKE AREA.

[Within Canal Zone.]

Location or section.	Americans.		All others.		Americans.		All others.		Total.
	Men.	Em- ployees.	Men.	Em- ployees.	Women.	Child- ren.	Women.	Child- ren.	
Upper Chagres.....									
Cano Quebrada.....			4				1		5
Agua Salud.....									
Trinidad River.....			5	1			6	3	14
Gatun River.....			3				1	8	12
Zerro Island.....			3				2	2	7
Total employees.....				1					
Total persons.....			15				10	13	38

MILITARY ORGANIZATIONS.

UNITED STATES ARMY.

Location.	Officers.	Enlisted men.	Women.	Children.	Total.
Ancon-Balboa Army Headquarters:					
Quarry Heights.....	16	190	10	9	225
Fort Grant.....	28	920	54	41	1,043
Corozal.....	44	1,008	76	63	1,191
Culebra.....	38	786	61	57	942
Empire.....	54	1,659	91	69	1,873
Las Cascadas.....	55	1,646	48	48	1,797
Gatun.....	13	250	19	15	297
Cristobal.....	4	20	9	11	44
Fort Randolph.....	11	218	19	28	306
Fort Sherman.....	15	425	17	12	469
Total persons.....	278	7,152	404	353	8,187

UNITED STATES NAVY.

Darien radio station.....	1	15	3	2	21
Balboa radio.....		5	2	3	10
Total persons.....	1	20	5	5	31

PRISONERS.

Location.	Americans.		All others.		Americans.		All others.		Total.
	Men.	Em- ployees.	Men.	Em- ployees.	Women.	Child- ren.	Women.	Child- ren.	
Balboa.....	2		21						23
Ancon.....			1						1
Pedro Miguel.....			39						39
Gamboa Penitentiary.....	3		49						52
Monte Lirio.....			1						1
Gatun.....			4						4
Cristobal.....	1		22						23
Total persons.....	6		137						143

TABLE XXII.—Board of Health Laboratory—Continued.

Miscellaneous—Continued.		Miscellaneous—Continued.	
Surgical pathological tissues and neoplasms reported	354	Blood for fat	1
Dark field examinations	46	Cremations	102
Vaccine inoculations, antityphoid	28	Water	4
Vaccine treatment, autogenous, prepared	21	Tallow	1
Wassermann reactions	6,518	Roast mutton	1
Animal inoculations	37	Butyric-acid tests on spinal fluid	7
Preparations of salvarsanized serum for intraspinal treatment	11	Fat determinations of milk	13
Vaccine points manufactured	15,310	Butyric acid	13
Interments	302	Paint	1
Animals autopsied	111	Heroin	1
Milk sediments	175	Chloride of lime	1
Ice cream	10	White brass	5
Alcohol	1	Examination of spots on clothing	1
		Specific gravity determination of stovain solution	1

Stations.	Anopheles-albimanus.	Anopheles-tarsimaculata.	Anopheles-argyritarsis.	Anopheles-malefactor.	Anopheles-apleimacula.	Anopheles-pseudopunctipennis.	Culex and allied genera.	Mansonia titillans.	Stegomyia (Aedes colopus).	Wyeomyia.	Deinocerites.	Aedes taeniorhynchus.	Anopheles-eiseni.	Lesticocmos.	Aedeomyia squamipennis.	Damaged Anopheles.	Total.
Ancon	59	1					2,907	29	201			1				2	3,200
Balboa	123						2,492	682	15			31				1	3,350
Corozal	329	1	2	1	1		344	601	4			27				1	1,315
Pedro Miguel	380	1	6	7			1,139	3,079	6			19				1	4,615
Paraiso	150		3	1	2		3,393	235	253			2				1	4,040
Red Tank	21						21					3				3	291
Lirio and Cerio	60		3				3,076	3,007	76								6,283
Rio Grande	171	1	1		9		1,305	4,568	90							1	6,146
Dredges, Culebra Cut	58						18,230	660	957			1					19,906
Tower R.	192						3,447	1,272									4,911
Gamboa	870	1					7,150	5,015	5							5	13,046
Other places in Pedro Miguel District	94		1	1	2		802	268	27							1	1,196
Gatun	8,444	198	1	35	6	2	3,070	230	126	351		23				1,906	14,392
Frijoles	22,394	60		9	1		18,045	6,141	15	15						4,587	51,267
Monte Lirio	14,348	10					2,696	1,877		10						3,619	22,560
Darien	701			2			4,138									5	4,846
Other places in Gatun District	168						4									4	176
Barracks, Cristobal	1,797	255		9	4		8,886	14	7			10				5	10,987
Mount Hope Village	2,048	168		5	2		7,806	32	41							44	10,147
Colon	259	28					1,458	21				25				4	1,795
Silver, married quarters and cars	448	22		1			3,182		6							8	3,607
Other places in Colon, Cristobal District	290	5	3				2,227	2	12							31	2,570
Camp Gaillard	35			8	1	5	5,509	7,630	9	79		21		7			13,304
Empire	1						2,235	1,163		1		2					3,408
Camp Otis	8						121	3,607				5					3,741
Fort Randolph	2,378	230					874	144		36		286				22	3,970
Fort Sherman	681	31		4			272	264				103					1,355
Total	56,507	1,008	9	92	18	28	104,829	40,850	1,850	465	36	561	1	7	2	10,251	216,514

NOTE.—The table of mosquitoes identified does not attempt to give comparable data for different stations, since the period covered is not equal for all places. For instance, collections were not begun at Fort Randolph and Fort Sherman until June, 1916.

5. For the Fiscal Year ended June 30, 1921:

Page 33: BUILDING AND OTHER CONSTRUCTION WORK.

The majority of the building forces of The Panama Canal worked during the year on construction jobs for the Army and Navy and for various companies that operate in connection with the canal. The building work done for the canal is referred to elsewhere. It consisted principally of construction of 49 buildings for silver-roll employees, construction of two concrete tanks for fuel oil, and building of stables at Colon for the Panama Railroad. Work referred to in this place is that for which the canal was reimbursed on the basis of cost for Army and Navy, and for outsiders on the "cost-plus" basis. On account of continually rising costs of materials and of labor, the cost of most of this work exceeded estimates.

United States Army. The barracks and quarters for accommodating one infantry regiment at Fort Clayton on the Pacific side and one at Fort Davis on the Atlantic side, jobs involving an expenditure of \$3,962,849, were completed during the year, so far as funds available would permit. Certain finishing work was left undone, but the posts were brought to the point where occupancy was practicable, and they have been occupied. Construction of quarters for the commanding officer at each post and of certain quarters for servants was deferred on account of a legal limitation as to cost in the former case and on account of lack of funds in the latter case.

The water, sewer, and drainage systems at Fort Clayton and Fort Davis and necessary grading and similar work were completed. Under a special appropriation of \$40,000, construction of an ordnance machine shop and a signal storehouse at Fort Randolph and a fire-engine house at Fort Amador was begun and carried practically to completion before the end of the year. A small locomotive shed and storehouse and a landing for small boats were constructed at Fort Sherman. Grading and making of a fill for the aero plane landing at France Field were almost completed at the close of the year. Other grading, road, and similar work was done for the Army at various points.

Work of a similar nature done for the Navy Department consisted of a prison at the submarine base at Coco Solo, a cottage at the Colon radio station, a boathouse at Darien radio station, and miscellaneous work.

6. For the Fiscal Year ended June 30, 1924:

Page 62: Under the heading of electrical work, this division completed during the past year, the wiring of the Gamboa penitentiary, installed the necessary ducts and

cables for a new pumping station at the Darien radio station, installed the cables and equipment for the emergency water pumping station in Miraflores Lake, installed electric equipment aboard the new floating relay pump station of the dredging division, performed considerable electrical work on ocean going vessels. The working force, as well as material and supplies, are interchangeable between the electric light and power system and electrical work, and the loss shown under this head is due more to clerical methods than to actual difference between costs and bills rendered for same.

7. For the Fiscal Year ended June 30, 1929:

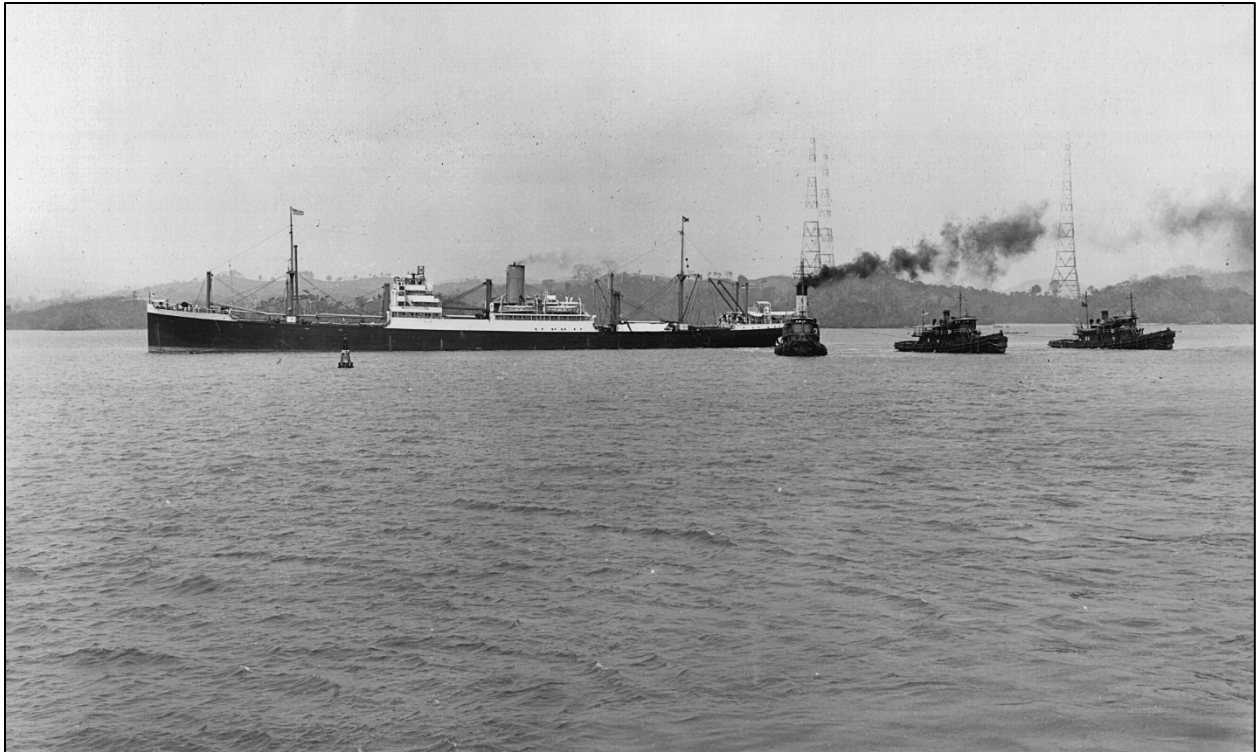
Page 33: AIDS TO NAVIGATION.

A gas and whistling buoy were established in the fairway off the Atlantic entrance to the canal. A gas buoy was placed on Commission Rock Shoal, off the Pacific entrance to the canal. The characteristics of the South Fraile gas and whistling buoy were changed. Flamenco Island Light was improved by installing a third order

lens in a new structure which was painted white for use as a daymark. A fog signal was installed on one of the towers of the Darien radio station; it consists of a green light of 250 watts, 300 feet above ground, the lighting of which indicates to pilots the existence of fog over Gaillard Cut or the narrow waters to the north of the cut. Material for radio beacons authorized by the Bureau of Lighthouses, Department of Commerce, for installation on Cristobal Mole and at Cape Mala was received, stored, and delivered to the sites. Various other aids were installed, adjusted, or maintained. At the end of the fiscal year the number of aids totaled 522, of which 121 were lit by gas, 281 by electricity, and 120 were unlighted.

8. For the Fiscal Year ended June 30, 1931:

Page 36: Dredging around grounded vessel. At about 2 p. m., March 31, 1931, the motorship Lochmonar of the Royal Mail Steam Packet Co., a vessel of 9,412 gross tons, 485.5 feet long, 62-foot beam with a mean authorized draft of 29 feet 6 inches, ran aground in the canal in San Pablo Reach, north of Buoy 67, during northbound transit, due to an error in executing order from canal pilot. In order to refloat the vessel, the dipper dredge Paraiso excavated a 40-foot channel the full length of the vessel on both sides. With the assistance of four tugs the vessel was refloated at 6 p. m., April 7, 1931. A total of 31,450 cubic yards of material was excavated by the dredge in refloating the vessel.



APRIL 1931 - SS LOCHMONAR, AROUND VICINITY DARIEN; TUGS TRINIDAD, CHAGRES AND GORGONA ASSISTING

Date	Vessel	Cause of accident	Estimated damage	Responsibility attributed to—
1930				
July 23	Jason.....	Struck float at Dock 17, Balboa.....	\$3,825	Vessel.
26	Armadales.....	Struck by canal tug Gorgona.....	1,500	Panama Canal.
Aug. 14	Vancouver City.....	Struck wing wall, Miraflores Locks.....	4,300	Do.
Oct. 6	Castilla.....	Struck by steamship Damsterdyk while undocking with canal tug assisting.	1,325	Do.
26	Losmar.....	Struck center wall, Pedro Miguel Locks.....	1,200	Vessel.
Nov. 27	Napier Star.....	Struck west bank of canal.....	1,600	Do.
Dec. 1	Willboro.....	Collision with steamship Benvorlich in Gaillard Cut.	11,300	Panama Canal
	Benvorlich.....	Collision with steamship Willboro in Gaillard Cut.	32,000	Do.
1931				
Jan. 20	Agwiworld.....	Struck wing wall, Miraflores Locks.....	3,850	Vessel.
Feb. 2	Robt. Luckenbach.....	Struck soft nose, Gatun Locks.....	1,300	Do.
23	H. M. S. Nelson.....	Struck chamber wall, Gatun Locks.....	1,400	Panama Canal,
23	do.....	Struck lock wall, Miraflores Locks.....	1,200	Do.
Mar. 1	Sun.....	Struck by canal supply boat No. 2.....	1,400	Do.
20	Pennsylvania.....	Struck lock wall, Gatun Locks.....	1,200	Do.
31	Lochmonar ¹	Grounded in San Pablo Reach.....	(²)	Vessel.
Apr. 10	Empress of Australia.....	Struck wing wall, Pedro Miguel Locks.....	2,500	Do.
June 11	Pacific Cedar.....	Struck center wall, Gatun Locks.....	2,500	Do.

¹ Such interior examination of the Lochmonar as was possible, and exterior examination by diver, indicated that the vessel had sustained no damage as a result of grounding. Canal charges for salvage operations, dredging, lightering, tug service, etc., in refloating the vessel amounted to \$10,103.34. The vessel was delayed at the canal 10 days as a result of the grounding.

² Undetermined.

9. For the Fiscal Year ended June 30, 1932:

Page 38: Dredging around grounded vessel. At about 5 p. m., September 20, 1931, the steamship President Lincoln, of the Dollar Line, a vessel of 14,187 gross tons, 516.5 feet long, 72.2-foot beam, and with a mean draft of 29 feet, while in transit through the canal, ran aground south of buoy No. 78, approximately midway between Gamboa and the Darien radio station. In order to refloat the vessel, the dipper dredge Gamboa excavated a 40-foot channel from deep water to the bow of the ship, after which, with the assistance of tugs, the vessel was refloated. A total of 16,500 cubic yards of material was excavated in connection with this work.

10. For the Fiscal Year ended June 30, 1935:

Page 38: POWER FOR CANAL OPERATION.

Work was started in connection with the installation of two 5,333-kilowatt-ampere transformers at Balboa substation, which work includes replacement of switch gear connected therewith and rearrangement of switch gear for the synchronous condenser in that station. These transformers replaced transformers at this station which had become obsolete and of insufficient capacity for our present requirements. Modern metal-clad switch gear was installed at the Summit substation, which apparatus replaced obsolete switch gear there and provided facilities for two new feeders for serving the new naval radio station at Summit.

Page 51: ACCIDENTS TO SHIPPING.

The board of local inspectors conducted investigations and submitted reports on 28 accidents of a marine nature occurring to vessels either in transit or in the terminal ports of the Canal, as compared with 34 last year and 26 the year before. Classification of the 28 accidents shows the following: Struck docks, 5; struck Canal bank, 4; line fouled propeller, 4; struck lock wall, 3; anchor damaged submerged cables, 2; damaged by wash of passing vessel, 2; grounded, 2; sunk, 1; fouled by another vessel, 1; hose burst while fueling, 1; struck submerged object, 1; broke bitt, 1; explosion and fire, 1.

In August 1934, the Japanese steamer Venice Maru, outward bound from Balboa, discovered fire in her hold and returned to Balboa. The Panama Canal salvage tug Favorite, assisted by other Canal craft, extinguished the fire by midafternoon of the following day. The steamship Harlinger went ashore in Tavernilla Reach September 18, 1934, and was towed to Cristobal by the Favorite.

The Favorite also towed the Peruvian steamer Maranon to Cristobal after it had radioed for assistance from latitude 9.29 north, longitude 78.10 west, on January 4, 1935, and on January 21, 1935, picked up a disabled United States Navy seaplane and crew of five near Iguana Island, off Cape Mala. The steamship Wisconsin went hard aground in the Canal during a fog, about 500 feet south of the Darien radio station, on the morning of February 17, 1935. With the assistance of dredging equipment, this vessel was refloated on the morning of February 20.

Page 62: ELECTRICAL INSTALLATION AND REPAIR WORK.

Summit substation: this apparatus replaced obsolete switch gear at this station and provided facilities for two new feeders for serving the new naval radio station at Summit. Approximately 8 miles of the transmission line, between Cristobal and Mindi, and between Miraflores and Balboa, were equipped with an additional ground wire over the middle wire of each of the two transmission lines. The addition of this second ground wire is to further reduce interruptions to the transmission line service by lightning.

Considerable underground distribution work for electric power and lighting, telephone, and streetlights was performed in connection with the 1935 building program at Gatun. At the time of raising and rebuilding the Randolph Road, the duct line along it was also rebuilt. The 11,000-volt overhead pole line to Coco Solo, which parallels the road, was relocated in part to eliminate road crossings. In connection with the flood-warning system for long-distance transmitting, indicating and recording of water levels between Madden Dam and stations at up-river points, two multiple-conductor armored submarine cables were laid on the bed of Madden Lake to replace two temporary pole lines. The 11,000-volt pole line from Summit substation, serving dredging activities along the Canal was rerouted to clear the navy radio reservation at Summit.

Page 110: Gaillard Highway, Paraiso to Summit. The appropriation for this project provided for surfacing a mile and one-half stretch of macadam road extending from the end of the concrete pavement part way up Paraiso Hill to the junction with Madden Road near Summit. Practically all the work on this project was completed in 1935.

CANAL



RECORD

PUBLISHED WEEKLY UNDER THE
AUTHORITY AND SUPERVISION OF
THE ISTHMIAN CANAL COMMISSION

AUGUST 28, 1912, TO AUGUST 20, 1913

VOLUME VI
WITH INDEX

ANCON, CANAL ZONE
ISTHMIAN CANAL COMMISSION
1913.

V. The Panama Canal Record (1913-1929)

1. Volume VI - July 30, 1913 - Page 416:

DARIEN RADIO STATION. New High-Power Plant will Communicate with Washington Direct. Construction is to begin shortly on the large Naval radio station at Caimito, to be known as the Darien Radio Station. This is to be a 100-kilowatt plant of the same power as the Arlington station, near Washington. In the size of its towers, it will exceed the latter; all the three masts will be 600 feet high, whereas at Arlington one of the towers is 600 feet in height, and two are 450 feet high. The bases of the towers will be about ISO feet above sea level, and they will be arranged in a triangle, approximately 900 feet on a side. The sending and receiving radius will be nominally 3,000 miles, so that communication may be held directly with the Arlington station, instead of by way of Key West, as at present. The station will be able to "talk" to San Francisco, 2,785 miles away by air line. The present stations at Colon and Balboa will be continued in use, to handle messages for ships using the Canal, and the Caimito station will be used exclusively for official business of the Government, principally as a relay station for communicating with ships of the Navy in southern waters. It will be able to send messages as far as Valdivia, 421 miles south of Valparaiso; and, on the Atlantic side of South America, as far down as Buenos Aires. It could reach a vessel anywhere along the eastern coast of the United States, or midway between New York and Gibraltar, on the Mediterranean route; in approximately east and west lines, it could communicate with the island of St. Vincent, 500 miles west of Africa. In sending, the station will use the Poulsen wireless apparatus, employing sustained oscillations, considered an improvement on the spark method. Situated between the Canal and the Panama railroad, its antenna will span an arm of Gatun Lake. The water will afford good electrical grounding and furnish the waves a good "grip" in starting. The Federal Company, which is operating stations along the west coast of North America, has a contract for furnishing the apparatus. The Navy Department has authorized the Isthmian Canal Commission to construct the following buildings, at estimated costs as shown: Powerhouse, \$7,500; operating buildings, \$4,600; quarters for operators, \$7,600; total, \$20,000. The Penn Bridge Company is the contractor for the towers; the concrete footings for them will be installed by the Canal Commission. Forces of the Quartermaster's Department will have charge of the work to be done by the Commission. Lieut. R. S. Crenshaw, U. S. Navy, is stationed on the Isthmus in charge of radio stations.

2. Volume VII - November 5, 1913 - Page 97:

Progress on High-Power Radio Station. The Penn Bridge Company of Beaver Falls, Pa., which has the contract from the Navy Department for the fabrication and erection of the three 600-foot towers for the proposed Darien radio station at Caimito. has let a subcontract to the Central American Construction Company of Colon to do the work of erection. None of the material has arrived on the Isthmus. Forces of the Quartermaster's Department of the Isthmian Canal Commission are engaged in the preliminary work of erecting the foundation piers of concrete for the towers.

3. Volume VII - November 26, 1913 - Page 127:

WIRELESS TELEGRAPH STATION. The buildings for the Darien radio station - powerhouse, operating buildings, and operators' quarters- were staked out on the last of the month. Two and one-half foot contours were taken over the footings for the three towers on the sites selected by the Navy Department. Topography was taken over average sections of 100 feet square for each footing and additional topography taken where the formation of the ground warranted it. Maps were drawn up, one showing the relation of the three towers to each other and to the topography, and three, taking each tower separately, showing the location of each footing in detail.

4. Volume VII - January 28, 1914 - Page 218:

RADIO STATION. Surveys were continued at the site of the Darien radio station at Caimito; towers were located, topography was finished, and work was begun on laying out tower No. 1 for construction. Detail plans for the masonry footings were completed.

5. Volume VII - March 18, 1914 - Page 285:

WORK AT RADIO STATION. Tower Erection at Darlen Station to Begin Shortly. New Stations at Colon and Balboa. The preparation of the footings for the 600-foot steel towers of the proposed Darien radio station at Caimito is approximately 55 per cent completed. The first shipment of steel for the towers, for the fabrication and erection of which contract was awarded to the Penn Bridge Company of Beaver Falls, Pa., is expected to arrive on the Isthmus at the end of this month, or early in April. The Central American Construction Company has a subcontract with the Penn Bridge Company for the erection of the towers.

Because of the irregular topography at the site, locating the footings has been a matter of considerable difficulty, and several surveys and readjustments were made before the present situations were recommended. The present location, which was approved by the Navy Department on December 3, 1913, will place the center of tower No. 1 about 1,500 feet east of the east bank of the Canal; No. 2, approximately 896 feet north of No. 1; No. 3, approximately 765 feet from No. 2, and about 982 feet from No. 1.

Each of the towers will be built in the form of a steep triangular pyramid, with its base in the form of an equilateral triangle, 150 feet on the side. At each corner of the triangle will be a footing of concrete. The depth of excavation for the footings has varied from 12 to 28 feet below the surface of the ground, the greater depths being necessitated by the irregular surface elevations. The concrete bases will be rectangular in plan, 16 by 20 feet, and 10 feet deep.

The building to serve as quarters for the operators have been practically completed, by forces of the Quartermaster's Department of the Isthmian Canal Commission, and the requisition for furniture for this building has recently been approved by the Navy Department. The location and details of the powerhouse, operating buildings, and quarters for the officer in charge are subject to further consideration before final approval.

New radio stations for relatively local use, as compared with the long-distance service of the Darien station, are to be erected at Colon and Balboa, and will supplant the ones now in service at those points. Each of them will have two 300-foot steel towers, 600 feet apart. The present wooden masts at Colon are about 200 feet high, and the antennae of the present Balboa stations are suspended at an elevation of about 110 feet above the ground, between one steel tower and the stack of the power plant.

The new station at Colon will occupy the same site as the present station, adjoining the east limit of the grounds of Colon Hospital. No decision has been reached as to the site of the Balboa station. A proposed location near the outer end of Dump 5 was found to be within the extreme angle of fire from the fortifications, and the selection of another site in the same locality, but not interfering with the reservations for barracks and for the quarantine station, has been referred to a board of officers.

6. Volume VII - May 13, 1914 - Page 369:

"Radio Station" Changed to "Darien". PANAMA Railroad Company, Office of Superintendent, Colon, R. P. April 29, 1914.

Circular No. 427: All concerned - Effective at once, the station on the Panama railroad, now known as "Radio station," is changed to "Darien." in accordance with the designation given by the Navy Department to the wireless installation at that point.

F. R. Blunf, Acting Superintendent.

7. Volume VII - May 20, 1914 - Page 377:

Radio Stations. The erection of a temporary radio station at Balboa, begun by forces of the Marine Corps on February 10, was completed by them in June. This station, like the Colon station, was opened to commercial service, both having wire connections with the Panama railroad telegraph. The location of the new permanent stations at both Balboa and Colon, to use 300-foot masts, has been decided, and the construction of the foundations is under way.

Bids for the erection and equipment of the high-power station at Caimito, now known as Darien, were opened on May 10, 1913. The contract for furnishing the equipment was awarded to the Federal Telegraph Company, and that for the erection of the 600-foot towers to the Penn Bridge Company. The locations for the buildings were staked out in October, and the operators' quarters have been completed. The first shipment of steel for the towers is expected to arrive soon, and erection is to begin immediately afterward.

8. Volume VII - May 27, 1914 - Page 385:

Progress on Transisthmian Duct Line. In the laying of the transisthmian duct line for telegraph and telephone cables, which began on April 14, at Gamboa, the trench for the duct has been dug as far as Frijoles, slightly over nine miles, to the morning of May 27. The duct has been laid and concreted to within a mile of Frijoles, and has been backfilled and otherwise completed, except for the manhole covers, to a point about two miles south of Frijoles, or over two miles north of Darien.

9. Volume VII - June 10, 1914 - Page 412:

Anemometer and Anemoscope at Darien Radio Station. An anemometer and anemoscope are to be installed shortly at Darien radio station by forces of the meteorological and hydrographic section of the Department of Operation and Maintenance. This is for the purpose of observing velocities and direction of wind currents during the erection of the 600-foot towers of the station.

June 24, 1914.

THE CANAL RECORD

435

PANAMA RAILROAD COMPANY.

(PASSENGER TRAIN TIME TABLE NO. 18—IN EFFECT JUNE 23, 1914.)
COLON-PANAMA MAIN LINE SERVICE.

SOUTHWARD.				STATION.	NORTHWARD.				
FIRST CLASS.					FIRST CLASS.				
Saturday only.	Daily.				Dis- tance from Colon.	Daily.			Sun- day only.
	71	7	5			3	4	6		8	72
P. M.	P. M.	A. M.	A. M.	Lv.		A. M.	P. M.	P. M.	A. M.
11.30	4.30	11.00	7.00	Colon	0	9 10	12.35	7.05	1.00
11.35	4.35	11.05	7.05	Mount Hope.	1.57	9 05	12.30	7.00	12.55
11.42	4.42	11.12	7.12	New Gatun	5.94	8.58	12.22	6.52	12.49
11.45	4.45	11.15	7.15	Gatun	6.79	8.56	12.20	6.50	12.47
11.56	4.57	11.27	7.27	Monte Lirio	14.48	8.43	12.08	6.38	12.35
						P. M.			
12.07	5.08	11.38	7.38	Frijoles	20.92	8.32	11.57	6.27	12.24
12.14	5.15	11.45	7.45	Darien	25.27	8.25	11.50	6.19	12.17
12.22	5.24	11.55	7.54	Gamboa	30.26	8.16	11.42	6.10	12.08
		P. M.							A. M.
12.32	5.34	12.05	8.04	New Culebra	35.19	8.04	11.32	6.00	11.59
12.42	5.45	12.20	8.16	Pedro Miguel Jct.	40.24	7.51	11.22	5.49	11.49
12.47	5.50	12.25	8.21	Miraflores Locks	42.35	7.44	11.15	5.43	11.44
12.50	5.55	12.30	8.25	Corozal	44.24	7.40	11.10	5.40	11.40
12.55	6.00	12.35	8.30	Balboa	46.25	7.35	11.05	5.35	11.35
1.00	6.05	12.40	8.35	Panama.	47.61	7.30	11.00	5.30	11.30
A. M.	P. M.	P. M.	A. M.	Arr.		A. M.	A. M.	P. M.	P. M.
71	7	5	3	J. Flag.		4	6	8	72
				†Telegraph station.					

Northward main line passenger trains will wait at Pedro Miguel Junction for connections from Las Cascadas branch trains, and southward Las Cascadas branch shuttle trains will wait at Pedro Miguel Junction for southward main line connections unless otherwise instructed.

PANAMA-PEDRO MIGUEL JCT. SHUTTLE TRAIN SERVICE.

SOUTHWARD.							STATION.	NORTHWARD.						
SECOND CLASS.								SECOND CLASS.						
Sunday only.		Daily.						Daily.					Sun-day only.	
55	53	51	49	45	43	41		40	42	44	46	50	52	54
P. M.	A. M.	A. M.	P. M.	P. M.	A. M.	A. M.		A. M.	A. M.	P. M.	P. M.	P. M.	A. M.	P. M.
9.45	2.08	12.01	7.09	1.53	11.08	7.38	Leave.	6.20	8.42	12.35	2.20	10.50	1.00	8.35
9.50	2.13	12.06	7.14	1.58	11.13	7.43		6.25	8.47	12.40	2.25	10.55	1.05	8.40
9.54	2.19	12.10	7.19	2.03	11.18	7.48		6.30	8.52	12.45	2.30	11.00	1.10	8.45
9.58	2.23	12.13	7.22	2.07	11.22	7.52		6.35	8.57	12.50	2.35	11.05	1.15	8.50
10.00	2.25	12.15	7.25	2.10	11.25	7.55		6.40	9.02	12.55	2.40	11.10	1.20	8.55
10.05	2.30	12.20	7.30	2.15	11.30	8.00	Arrive.	6.45	9.07	13.00	2.45	11.15	1.25	9.00
P. M.	A. M.	A. M.	P. M.	P. M.	A. M.	A. M.		A. M.	A. M.	P. M.	P. M.	P. M.	A. M.	P. M.
55	53	51	49	45	43	41		40	42	44	46	50	52	54
							†Telegraph station.							

LAS CASCADAS BRANCH.

SOUTHWARD.								STATION.	NORTHWARD.										
SECOND CLASS.									SECOND CLASS.										
Sunday only.		Daily.							Daily.						Sunday only.				
55	53	51	49	47	45	43	41					40	42	44	46	48	50	52	54
P. M.	A. M.	P. M.	P. M.	P. M.	P. M.	P. M.	A. M.	A. M.	Leave.	†Las Cascadas	Arrive.	A. M.	A. M.	P. M.	P. M.	P. M.	P. M.	A. M.	P. M.
9.15	1.40	11.30	6.40	5.10	1.25	10.40	7.10		.....	†Empire		6.48	9.10	1.05	3.50	6.27	11.18	1.28	9.03
9.21	1.45	11.35	6.46	5.16	1.30	10.45	7.15		.....	†Culebra		6.42	9.04	12.58	3.43	6.21	11.13	1.23	8.58
9.26	1.50	11.40	6.51	5.21	1.35	10.50	7.20		.....	†Parrain		6.36	8.58	12.57	3.37	6.13	11.08	1.18	8.53
9.42	2.05	11.57	7.06	5.36	1.50	11.05	7.35		.....			6.23	8.43	12.38	3.23	6.00	10.53	1.03	8.38
9.45	2.08	12.01	7.09	5.40	1.53	11.08	7.38		Arrive.	†Pedro Miguel Jct.	Leave.	6.20	8.40	12.35	3.20	5.57	10.50	1.00	8.35
P. M.	A. M.	A. M.	P. M.	P. M.	P. M.	A. M.	A. M.					A. M.	A. M.	P. M.	P. M.	P. M.	P. M.	A. M.	P. M.
55	53	51	49	47	45	43	41					40	42	44	46	48	50	52	54

COLON-GATUN SHUTTLE TRAIN SERVICE.

SOUTHWARD.					STATION.	NORTHWARD.				
SECOND CLASS.						SECOND CLASS.				
127	125	123	121			122	124	126	128	
P.M.	P.M.	A.M.	A.M.			A. M.	A. M.	P. M.	P. M.	
5.00	1.30	9.30	5.50	Leave.	Third Street, Colon	Arrive	6.50	10.40	6.00	
5.01	1.31	9.31	5.51	.....	Fifth Street, Colon	.....	6.47	10.38	5.58
5.03	1.33	9.33	5.53	.....	Passenger station, Colon	.....	6.45	10.36	5.57
5.05	1.35	9.35	5.55	.....	Commissary, Cristobal	.....	6.43	10.34	5.55
5.07	1.37	9.37	5.57	.....	Shops, Cristobal	.....	6.41	10.32	5.53
5.11	1.41	9.41	6.01	.....	Mount Hope	.....	6.37	10.27	5.48
5.17	1.47	9.47	6.07	.....	Mind	.....	6.31	10.21	5.42
5.22	1.52	9.52	6.10	.....	New Gatun	.....	6.28	10.18	5.38
5.25	1.55	9.55	6.13	Arrive.	Gatun	Leave.	6.25	10.16	5.35	
P.M.	P.M.	A.M.	A.M.				A. M.	A. M.	P. M.	
127	124	123	121		Trains stop at all stations.		122	124	126	128

10. Volume VII - June 10, 1914 - Page 415:

Changes in Line Stations on Panama Railroad. The department of bridges and buildings of the Panama railroad will erect a standard shelter and alighting platform at Darien flag station. The shelter will be built of old material, taken from storage. It will be generally like that recently erected at Miraflores Locks station; this shed was formerly alongside the siding, north of the Calidonia bridge, which was the Panama terminus for labor trains before the opening of the new station.

The old Miraflores station, which stood about 200 feet from the north end of the tunnel, has been trans, erred to Gamboa. Alighting platforms, with shelters, have been built at the Bishop's Hollow and Tivoli road stops for trains on the Panama-Balboa line. An alighting platform has been built at the new stopping point for Paraiso, and the erection of a shed was completed last week. The shed at Corozal station has been lengthened.

11. Volume VII - July 22, 1914 - Page 478:

BUILDING 600-FOOT TOWERS. Erection of Steel at Darien Radio Station Has Begun. The erection of steel in the first of the three 600-foot steel towers for the Darien radio station was begun on Thursday, July 9. The construction forces of the contractor for their erection have been engaged in preliminary work since the early part of June. They have assembled the principal parts of the plant, including a hoisting engine, cables, ropes, derricks, and timber for erection staging and falsework, have handled the first sections of steel to the site of tower No. 1, and have completed at this site a 150-foot timber tower from which to handle the steel to the 200-foot level.

This erection tower has been built in the center of the site of the steel tower, equidistant from the three footings, which are set in an equilateral triangle, 150 feet on the side. It has been surmounted by a stiff-legged derrick, with a 60-foot boom, which can revolve in a complete circle and be used, without further adjustment, for working over the three columns. The steel will be swung into place by derrick and be secured and supported by timber falsework. When it is completed to the 150-foot level it will be self-supporting by reason of struts and cross-bracing. The three legs batter inward, so that at the 150-foot level they will form the points of an equilateral triangle, 75 feet on the side. The faces of the concrete footings have been inclined from the horizontal sufficiently to be perpendicular to the columns with this batter. The base girders and anchor bolts have been set in the concrete on a line with the batter of the columns.

The derrick set on the 150-foot timber tower will handle the steel to the 200-foot level. When the steel has been carried to the 200-foot level, the timber tower and derrick will be dismantled and transferred to the site of tower No. 2. The contractor has not decided the method of operation above the 200-foot level, but it will probably be an adaptation of the gin pole: a pile or other heavy timber with a sheave on the upper end will be rigged to the highest section of the steel column, and the next section will be hoisted into place, lashed, and bolted. At the 200-foot level the columns will be 15-inch I-beams, and the pole can be fitted into the groove along the back of the beam.

The plan of the tower becomes constantly smaller as it approaches the top, where it will be only 10 feet on the side. The steel, accordingly, becomes lighter and lighter. Above the 400-foot level the material will be so light, relatively, that the men will work from the inside, and the gin pole will be abandoned for a small derrick, toward the top the steel will be handled into place by hand line. About 800 tons of steel have been delivered to the Isthmus. This is approximately that for the first 200 feet of towers Nos. 1 and 2; none of the steel for tower No. 3 has been delivered. The towers are identical, except that No. 3 has one short leg. A total of slightly over 960 tons of steel will be used.

The contractor for the fabrication and erection is the Penn Bridge Company of Beaver Falls, Pa. This company sublet the fabrication of all the steelwork to the Toledo Bridge and Crane Company of Toledo, Ohio, and the erection to the Central American Construction Company, Limited, of Colon. After the latter corporation was placed in the hands of a receiver, in March 1914, the Penn Bridge Company made a second contract for the erection with Mr. J. O. Childers of the Childers Construction Company of Columbus, Ohio. Mr. Childers was once a superintendent for the Penn Company and was field superintendent for the McClintic-Marshall Construction Company in its work on the Canal, principally in the erection of the lock gates. He arrived on the Isthmus to take charge of the work at Darien about the middle of April. His present force consists of 12 white men and 13 West Indian negroes. Forces of the Supply Department, numbering one gold and about 50 silver employes, are engaged in finishing the grading and filling about the concrete footings for the towers, and in the erection of a concrete operating building, one story in height and 26 by 50 feet in plan. They have completed a one-story concrete powerhouse, quarters for the operators, and a cottage for the chief electrician. The Navy Department has a chief electrician on the grounds, supervising eight silver employes in handling miscellaneous materials and stores.

EXECUTIVE ORDER. Rules and Regulations for the Operation and Navigation of the Panama Canal and Approaches. Thereto, Including All Waters Under Its Jurisdiction. RADIO COMMUNICATION AND REPORT:

40. As soon as radio communication can be established with the Canal, vessels should report their names, nationality, length, draft, tonnage, whether they desire to pass through the Canal require coal, provisions, supplies, repairs, to go alongside of a wharf, the use of tugs, probable time of arrival, length of stay in port, or any other matters of importance or interest. If this information has been previously communicated, through agents or otherwise, to the captain of the port, it will not be necessary' to report by radio, but the probable time of arrival should always be sent.

41. Control of radio communication is entirely in the hands of the radio shore stations. No vessel will be allowed to interfere in the slightest degree with the Canal radio stations; upon an order being received by a vessel at any time while within the waters under the control of the Canal, to discontinue using radio, even if during transmission of a message, she shall immediately comply.

42. Upon a ship's arriving within the 15-mile limit, and until leaving the 15-mile limit of the Canal Zone, she shall transmit only with low power, not exceeding $\frac{1}{2}$ -kilowatt.

43. Messages to stations will be sent only to Colon station (NAX) when in Gatun Locks and to northward thereof, and only to Balboa station (NPJ) when in Miraflores Locks and to southward thereof; between these two points, ships may work to either station, preferably to the nearer one; the high-power station, (DN) at Darien, will not handle commercial work and will not be called for Canal business, except in case of emergency.

44. All messages between ships in the Canal Zone and ships at sea must be forwarded through the nearest shore station.

45. Messages from ships in the Caribbean Sea for ships in the Pacific waters, or vice versa, shall be routed through the Canal Zone shore stations.

46. All vessels- fitted with radio, after leaving the terminal harbor to pass through the Canal, shall keep an operator on watch until the further terminal harbor has been reached; this applies to the time when they are anchored in Gatun Lake, while passing through the locks, or moored to the lock walls, or to any of the wharves in

the Canal proper, as well as when they are under way. Messages relating to the ship's movements and the Canal business shall take precedence over all commercial messages.

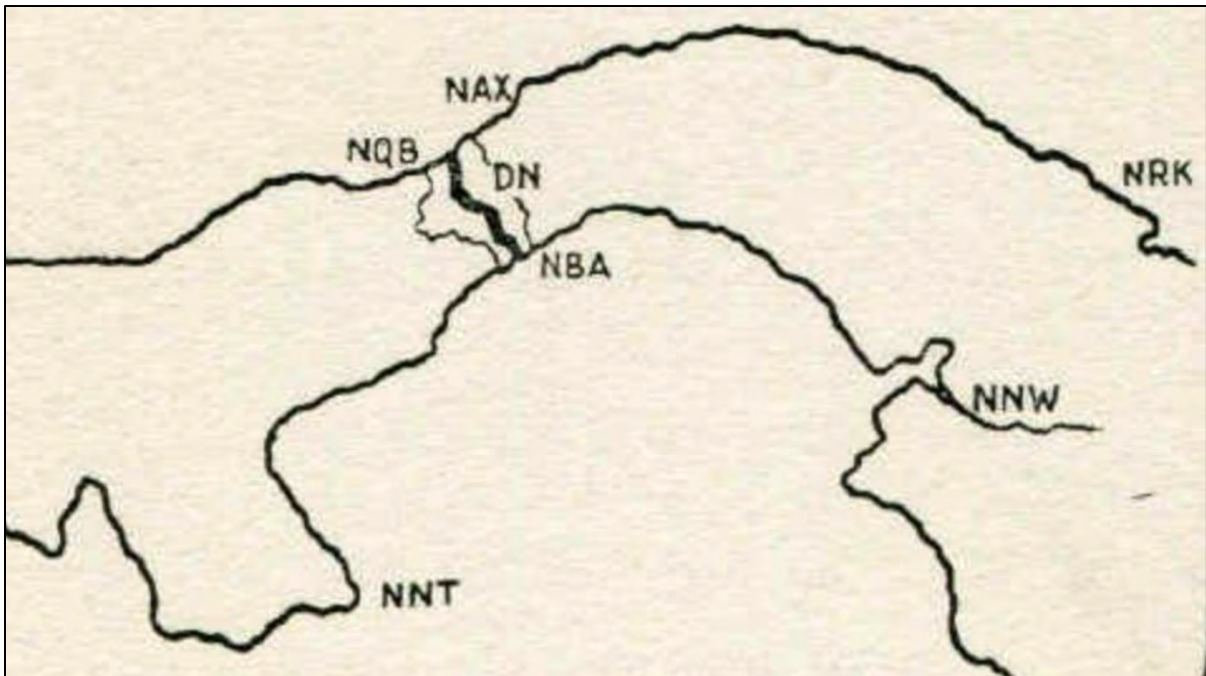
47. Pilots on vessels passing through the Canal shall have the right to use the vessel's radio freely for the transaction of the Canal business.

48. Under the direction of the pilots, vessels will, from time to time, report their progress through the Canal; accidents to machinery, propellers, steering gear, equipment, or anything else that may delay them or require assistance; any sickness or casualties that require medical attendance from Canal officials; or any other matters of importance that may arise.

49. No charges will be imposed against the Canal by vessels receiving or sending messages in relation to Canal business.

50. No vessel will be allowed to communicate with any lock or signal station while in transit through the Canal, except through the pilot; all messages of any kind must be sent through him. This does not apply to vessels moored at the terminals at Cristobal or Balboa, before entering, or after having passed through the Canal, which may wish to communicate through the terminal stations.

51. Vessels in transit through the Canal can communicate with the locks and signal stations, through the pilots, both by the international code and special signals; information on this subject may be obtained from the Governor of The PC.



TERMINAL RADIO STATIONS. Plants of Greater Capacity Under Construction at Colon and Balboa. As a part of the equipment of the Canal, new and larger radio stations are being constructed at Colon and Balboa to supplant the present stations in communicating with ships of the Army and Navy and commercial vessels within a normal operating radius of 500 miles from the Canal. Their service will be like that of the present stations but will exceed in area the present 300-mile daytime reach of the present station at Colon, and the 200-mile daytime range of Balboa station. The Colon station will be equipped with two interchangeable sets, the smaller to be used regularly for local work, and the larger to be switched in for farther communication when desired. The large set will be capable of communicating as far as Key West and may thus be substituted for the Darien high power station in communicating with the United States, if the need arises. The larger set at Colon will use the equipment of the present station.

The Colon and Balboa radio services, while primarily for naval and military work in connection with the Panama Canal, and secondarily for shipping, will be used for all official communication with ships approaching or departing from the Canal, or in transit through the Canal. They will be opened, as the present stations are, to commercial service, under restrictions subordinating this use to Government needs and under the further restrictions imposed by international convention, such as, for example, the ruling that Government radio services may not be used for commercial messages between points in connection with privately owned submarine cable or overland wire service. The Colon and Balboa services will, further, be distinct from the service of the high-power station at Darien, which will be used, except in case of emergency, for official business, communicating directly with the Arlington station near Washington and relaying messages to Government ships within a nominal radius of 3,000 miles of the Isthmus.

The new stations at the ends of the Canal will be practically identical in form, except that the Colon station will have a slightly larger powerhouse, to accommodate the two sets of sending apparatus. At each the antenna will be stretched between two 300-foot steel towers, 600 feet apart. Each tower will be self-supporting, resting on three footings, arranged in an equilateral triangle, 60 feet on the side. The footings, which have been completed, with anchor girders, are blocks of concrete, nine feet square in plan, resting on piles driven through fill to rock. At Colon, where the piling is below sea level, timber piles were used, but at Balboa, on account of higher elevation. reinforced concrete piles were driven.

The power houses, alike, except for the slightly greater size of the one at Colon, are adjoined by identical operating rooms, with an office beyond, all built of reinforced concrete, and one story in height. Suitable underground duct will be laid for the connecting wires; the high potential wires connecting with the antenna will pass through the center of a plate glass window. The powerhouse and the operating room are in separate buildings, 15 feet apart, but connected by a covered portico, so that there may be no difficulty in passing from one to the other during a storm.

New quarters for the operators are part of the construction. At each station a 1-story 2-family frame house, and a 2-story frame barracks, or bachelors' quarters with mess and room accommodations for six men, are under construction. All the quarters at both stations are under roof, and the interior finishing is in progress. The walls and roofs of the power houses and operating buildings have been built, and finishing off the walls and making ready the interiors is under way.

The new station at Colon is to occupy the present station grounds, between the Colon Hospital grounds and the quarantine house for steerage passengers. The area devoted to the station will probably be enlarged in the future by the removal of the quarantine house and the incorporation of its grounds in a Naval reservation. Such reservation has been made for the new radio station at Balboa, which occupies a site on the Balboa dump, about 4,000 feet out from the present commissary store, 6,500 feet inland from the land end of Naos Island breakwater, and approximately 1,000 feet west of Gabilan Rock, which is offshore from Punta Mala. The buildings overlook the Bay of Panama, east of the dump and the breakwater, and are visible from parts of the city of Panama.

Both stations will receive power from the Canal Transisthmian electric system, developing it through transformers to the potential required for operation. They will use a different system of radiation from that proposed for the Darien station, so that there will be no interference. They will conform to the international convention, using a wavelength of 600 meters for communication with commercial ships, and from 1,000 to 2,500 meters for naval work.

14. Volume VII - August 19, 1914 - Page 523:

EXECUTIVE ORDER. Setting Aside Area of Land for Use and Purposes of a Radio Station.

The area of land hereinafter described, situated in the Canal Zone, is hereby set apart and assigned to the uses and purposes of a radio station and other naval purposes under the control of the Secretary of the Navy, but said area shall be subject to the

civil jurisdiction of the Canal Zone authorities in conformity with the Panama Canal Act. The said area is described, as follows:

DARIEN NAVAL RADIO STATION.

Beginning at a point A on the map, which is the point at which the water level of Gatun Lake meets a line parallel to the center line of the Panama railroad and 100 feet distant therefrom on the side toward the Canal, this meeting point being the first such point south of Station 1051 plus 70.3 of the Panama railroad, which latter point is marked by an iron rail monument noted P on the map; continuing thence on the line A, B, C, D, E, F, G, H, I, which line is at the water level of Gatun Lake, and is a meandered line extending southwesterly, south, and easterly, to point I, where the said water level intersects a traverse line shown on the map as of azimuth $250^{\circ} 02'$; thence for a distance of about 130 feet to point J, which is the intersection of two traverse lines indicated on the map as of azimuth $250^{\circ} 02'$ and $1^{\circ} 54'$, respectively; thence for a distance of 433.8 feet on an azimuth of $1^{\circ} 54'$ to point K on the map, this point being the intersection of the $1^{\circ} 54'$ azimuth line with the aforesaid parallel to and 100 feet distant from the center line of the Panama railroad, immediately south of Station 1074 plus 52 on the Panama railroad, which latter point is marked with an iron rail monument and is noted Q on the map; thence along the aforesaid line parallel to the Panama railroad to the point of beginning; in all, 87.5 acres, more or less.

The areas below lake level forming indentations into the general area of the site beyond lines B - C, C - D, E - F, G - H, and J - K, are included in the area hereby set aside; all as shown by the blueprint No. 3846, dated March 30, 1914, issued by the Department of Construction and Engineering, Isthmian Canal Commission, Office of the Assistant to the Chief Engineer.

Woodrow Wilson. The White House, July 30, 1914. [No. 2006.]

15. Volume VIII - September 2, 1914 - Page 9:

Transisthmian Duct Line Reaches Cristobal. Excavation for the northern section of the 4-way transisthmian duct line for telephone and telegraph and railway signal cables was completed on Thursday, August 20. This section extends from Gamboa to Fourteenth street, Cristobal, at a point near interlocking tower A of the Panama railroad. On the southern section, from Gamboa to Balboa, excavation of the trench has reached Miraflores tunnel dump, and the laying of duct is in progress south of Pedro Miguel.

The laying and concreting of ducts in the northern section is in progress between Mount Hope and Cristobal. From a point opposite the pumping plant of the waterworks at Mount Hope, the line is to be of doubled capacity, or 8-way, to Fourteenth street, where it connects with a 12-way line which is the permanent trunk of distribution through Cristobal and Colon. The existing duct for the distribution system at the northern terminal has been completed for about a year, but authority was granted on August 21 for an additional line, 220 feet long, to extend from the manhole beneath building No. 2, Cristobal, to the new Pier 10, and for a 3,200-foot line to extend from the Garfield House, the present end of the line in the Colon Beach district, to the Colon radio station.

A branch will be laid up at Darien, and an extension built at Balboa, for the radio stations at those points. The line at Darien, branching directly off the main transisthmian line, will be about 300 feet long; a joint duct line for all cables for the Balboa radio station will extend beyond the Balboa townsite about 3,000 feet.

The pulling of cables into the completed portion of the duct has advanced from Gamboa to Mindi, in the northern section, and has not been begun in the southern section. Two cables are at present being pulled in two of the ducts; one is a duplex cable containing 50 pairs of wires, for the telegraph and telephone service, and the other is for the electrical control of the automatic signal system of the Panama railroad. Both cables have been spliced and tested to a point about seven miles north of Gamboa. The two other spaces of the 4-way duct are not to be occupied at present. One of these has been reserved for the Central and South American Telegraph Company, for its cable service, and the other for future requirements.

16. Volume VIII - September 2, 1914 - Page 13:

RADIO STATIONS. At Darien, the contractor proceeded with the erection of tower No. 1, and at the end of the month it had been erected as high as the 150-foot level. The design of the electrical substation was advanced.

17. Volume VIII - September 30, 1914 - Page 52:

RADIO STATIONS. Municipal engineering work was continued at the Colon, Balboa, and Darien radio stations. At Darien, the contractor completed the erection of the first 200 feet of tower No. 1, with the exception of the joints, and proceeded with the erection of tower No. 2.

18. Volume VIII - October 7, 1914 - Page 61:

Commissary Supply Trains to be Eliminated.

The extra train for carrying supplies to the line commissaries from Cristobal, and that for returning the empty cars to Cristobal for reloading, are to be abolished when the new schedule of the Panama railroad. No. 20, goes into effect. Instead, solid cars will be handled daily to the principal main line villages in the regular tonnage freight. No. 101, leaving Colon at 2 a. m., and arriving at Panama at 4.15; and twice a week to the villages on the Las Cascadas branch.

Perishable supplies, bread, and laundry for the villages on the branch line will be loaded in peddle cars daily, sent out on train No. 101, dropped off at the dump north of Miraflores tunnel, and picked up by the passenger train leaving Panama at 5 a. m., for Las Cascadas. This train, on its return trip to Panama, will drop these cars at the tunnel dump, and they will be picked up by the regular freight train No. 102, which will also take back to Colon the solid cars dropped at the principal main line towns by No. 101.

Perishable supplies for the minor points on the main line, including Mount Hope, Mindi, Lirio, Frijoles, Darien, Gamboa, Gamboa stockade. New Culebra, and Miraflores Locks, and extra deliveries for the principal towns, will be handled in a peddle car attached to the regular passenger train leaving Colon at 7.10 a. m., and dropped off like express matter at each stop for which there is a consignment.

19. Volume VIII - November 18, 1914 - Page 123:

The first of the three masts at the Darien radio station was erected to the full height of 600 feet on Wednesday, November 11.

20. Volume VIII - December 23, 1914 - Page 170:

Two Towers at Darien Radio Station Completed. The second of the three 600-foot towers of the Darien radio station was completed to its full height on Saturday, December 19. The third tower is now up about 100 feet and will probably be finished about February 1.

21. Volume VIII - February 3, 1915 - Page 223:

NOTES OF PROGRESS. Darien Station Receiving Messages from a Wide Area. Since the recent completion of the second of the three 600-foot steel towers for the high-power radio station at Darien, temporary receiving antennae have been rigged between these towers and receiving tests are being conducted. Messages are received

from Arlington, near Washington, D. C, and from San Francisco without difficulty. No messages have been transmitted from Darien station. The transmitting apparatus and power plant: have been installed completely, but the substation through which the power is to be supplied with electricity from the 44,000-volt transisthmian line has not been completed.

22. Volume VIII - March 10, 1915 - Page 265:

To Supervise Tests at Darien Radio Station. Dr. L. W. Austin, head of the Naval radio experimental laboratory at the Bureau of Standards in Washington, D. C, arrived on the Isthmus on Thursday, March 4, on duty with the Navy Department in connection with the receiving and sending tests to be conducted at the new Darien high power radio station. He will be stationed on the Isthmus for about two months. Dr. Austin, who is the president of the American Society of Radio Engineers, has recently aided in the development of a system of receiving circuits which has placed the United States practice considerably in advance of other countries in this part of wireless telegraphy.

23. Volume VIII - March 24, 1915 - Page 281:

ELECTRICAL DIVISION. The output of the power plants was Gatun hydroelectric station, 2,785,830 kilowatt hours; Miraflores steam station, 85,050 kilowatt-hours; Balboa power plant, 2,256 kilowatt-hours; total output, 2,873,136 kilowatt-hours.

The output of the Balboa air compressor plant was 129,438,628 cubic feet of free air, compressed to 105 pounds.

The electrical work at the substation at Gamboa for the new permanent pumping plant of the Municipal Engineering Division was completed and the substation was put in service during the month. Construction work on the substation at Darien for the high-power naval radio station progressed satisfactorily during the month. Construction work was carried on in connection with the installation of underground conduit systems in the Ancon, Balboa, and Cristobal districts; the electrification of the dry dock shops at Mount Hope; the construction of barracks, quarters, headquarters buildings, etc., at Fort Grant; the construction of various buildings at Balboa, and the new freight house in Panama City. The painting of the track-span bridges of the 44,000-volt transmission line was practically completed during the month.

24. Volume VIII - March 31, 1915 - Page 291:

Transfer of Radio Headquarters. Office of Radio Officer, Canal Zone, Naval Radio Station, Darien, C. Z., March 25. 1915.

To all departments - You are advised that on Thursday, March 25. 1915, the office of the Radio Officer of the Canal Zone was moved from the Colon radio station to the Darien radio station. It is requested that all correspondence, bills, and other matters to be handled through this office be addressed to the Radio Officer, Canal Zone. Naval Radio Station, Darien, C. Z.

R. S. Crenshaw, Radio Officer, Canal Zone.

25. Volume VIII - April 28, 1915 - Page 321:

Monthly Report of the Governor to the Secretary of War.

Balboa Heights, C. Z., April 19, 1915. The Honorable Secretary of War, Washington, D. C.

Sir: I have the honor to submit the following report of operations on the Isthmus for the month of March 1915:

... The electrical work at the Darien substation for the new high power Naval radio station was completed and the station put in service. Construction work was carried on in connection with the installation of the underground conduit system and street lighting systems in the Ancon, Balboa, Gatun, and Cristobal districts; the electrification of the dry dock shops at Mount Hope; the construction of barracks, the headquarters buildings, etc., at Fort Grant; the construction of the new commissary, dispensary, and railroad station at Balboa, of the new Panama railroad freight house in Panama City, and of the new commissary warehouse at Cristobal. The usual operation and maintenance work in connection with electric power and air compressor plants, substations, and transmission lines and the Balboa handling cranes was carried on.

26. Volume VIII - May 19, 1915 - Page 343:

Special Reservations in the Canal Zone. Construction work on the new Naval radio stations at Darien, Balboa, and Colon, is practically completed. At Darien the aerial mat was hoisted in April, and tests of the radio equipment furnished by the Federal Telegraph Company are now in progress. The station is in regular communication with Arlington, Va., and has received messages from other distant points. At Colon and Balboa, which are secondary stations, the antenna is swung from the new 300-

foot towers and the radio equipment is practically completed. The last wooden mast of the old Colon station will be taken down in the near future. These stations will be operated by the Navy Department, the operating force consisting of enlisted men of the Navy under the command of a commissioned officer.

The land on which the Darien and Balboa stations are located has been set aside by Executive Order for radio and other naval purposes under the control of the Secretary of the Navy, but these areas as well as all other areas and reservations for naval and military purposes in the Canal Zone are, in conformity with the Panama Canal Act, subject to the civil jurisdiction of the Governor of the Canal Zone. All sanitary and building regulations and all other laws of the Canal Zone apply with equal force to all portions of the Canal Zone, including all military or naval reservations embraced therein.

The Colon radio station is located on land of the Panama railroad. The Panama railroad holds this land in Colon under a qualified title of ownership which gives the company a leasehold estate therein to the end of the company's concession in 1966, at which time ownership will revert to the United States by virtue of the Canal treaty.

27. Volume VIII - June 2, 1915 - Page 363:

Breaking a Boat Channel through the Dying Jungle. A400-cubic yard barge, heavily loaded with rock from the Cut, was used for breaking a channel through inundated brush and dead trees between the Canal and a landing for motorboats on the edge of Gatun Lake at Darien, on Friday, May 28. The barge was pushed through the greater part of the distance of several hundred feet by the tug Reliance, after which the place of the Reliance was taken by the tender De Lesseps, which has a draft of only six feet, for clearing away the shallow parts. The boats succeeded in breaking up a floating island which blocked the way and clearing a channel to a minimum depth of about nine feet in less than an hour, after which the barge was dumped in one of the deeper parts. A floating pile driver was sent through the channel on Tuesday, June 1, to drive piles for the erection of a boathouse at the landing.

28. Volume VIII - June 9, 1915 - Page 367:

NOTES OF PROGRESS. Darien Radio Station Handling Government Messages.

The handling of Government messages between the Canal Zone and Washington, D. C, by way of Arlington, VA., was begun by the high-power Naval radio station at Darien on Saturday, April 5. This marks the working establishment of direct radio communication between the headquarters of the National Government and the

Canal Zone and is an important step in the establishment of a series of high-power stations by which messages may be relayed to vessels over almost all the central and north Atlantic, and over the Pacific north of latitude 30° South. The transmission of messages through the Darien station will be confined to official business, primarily that of the Navy, the Army, and the Department of State.

29. Volume VIII - June 30, 1915 - Page 391:

Vessels May Take Boiler Water from Gatun Lake. Steamship masters are advised that, with the agreement of the pilot, excellent boiler water may be taken up in Gatun Lake, preferably between Gatun Locks and Darien. South of Darien the water is likely to be muddied by the dredging operations in the Cut or by high waters in the Chagres River. The pilot can advise of the best place to take water. Southbound vessels of deep draft should confer with the pilot as to the advisability of taking water in Gatun Lake, as an increase in draft may affect the facility of handling the vessel past the part of the channel affected by slides. Northbound vessels which have passed through the Cut may take up all the water desired, without charge. The water in Miraflores Lake is slightly saline, as a result of infiltration from the Pacific Ocean. At present the degree of salinity is not sufficient to be distinctly injurious but it is better to take the entirely fresh water of Gatun Lake.

30. Volume VIII - August 11, 1915 - Page 443:

TERMINAL RADIO STATIONS.

With Increasing Business, They Facilitate the Handling of Ships at the Canal.

The Naval stations at Colon and Balboa erected especially for communication with vessels coming to the Canal or its terminal ports, are performing increasingly effective service in facilitating Canal operations and will be of even greater value when the masters of vessels shall have learned to make more use of them. Over half of the vessels coming to the Canal or its terminals are equipped with radio apparatus but only about a fourth of those so equipped have advised the authorities of their approach. It is distinctly desirable that vessels do so, as it is of considerable assistance to the Canal transportation forces, through acquainting them with the traffic problems to be met, and will greatly expedite the handling of vessels, both in the transit of the Canal, and in furnishing supplies. No charge is made against vessels for the handling of messages sent by the master relating to any of the subjects mentioned in paragraph 40 of Executive Order No. 1990, quoted below.

The Colon station is now handling approximately 2,300 messages per month, the Balboa station about 400, practically all in communication with vessels. Of these, about one-sixth are handled as a part of the Canal work, on which no charges are made. Their radio of communication has extended as far as 1,500 miles under favorable conditions, and in actual work the limit is usually the communicating radius of the vessel. The better equipped vessels will communicate with ease at a distance of 500 miles while a vessel of relatively small sending power may be unable to communicate from a point more than 100 or 150 miles from the station. Only in exceptional cases, however, would a vessel be unable to advise of her approach when 24 hours out from port.

The canal terminal stations use the Lowenstein 500-cycle spark sending system, and the international code. The high-power station at Darien, which handles Government work exclusively and has no direct communications with commercial vessels, uses the Poulsen system.

The Colon station broadcasts daily at 3.30 p. m. a news bulletin, made up of items taken from the press dispatches or any matters which might be of especial interest to vessels. Just after noon, daily, this station broadcasts on 1,400-meter wavelength a weather forecast received from Key West, covering the Caribbean and south Atlantic and Gulf regions. Also, as soon as received and at 8 o'clock a. m., noon, 4 p. m., and 8 p. m. are broadcast any hydrographic information covering dangers to navigation, such as wrecks, derelicts, etc., or changes in local navigation aids, and other important information.

It has recently been arranged, as a further convenience to commerce, that operators who wish business messages delivered to their vessels may file them with the radio stations, for delivery as soon as the vessel comes into communication. As these messages are of private commercial nature they are charged for, at the regular commercial rate, which charge may be included with the other items for the vessel's expenses at the Canal and collected from the deposit made to cover the ship's expenses.

For the benefit of masters who may desire to avail themselves of the advantages afforded by the Canal radio facilities, there are published below the sections governing radio operations, from the Executive Order No. 1990, establishing rules and regulations for the operation and navigation of the Panama Canal and the approaches thereto: [Volume VII - August 5, 1914 - Page 497].

WIRELESS TELEPHONY. Darien Radio Station Has Received Aerial Telephone Messages since August 27. In the recent tests of the wireless telephone, in the course of which speech was transmitted from the radio station at Arlington to Mare Island and San Diego, California, and to Pearl Harbor, Hawaii, the radio station at Darien played an interesting part which it has become permissible to reveal since the publication of the results in the United States.

In the development of the invention, begun early in the year, the American Telephone and Telegraph Company established a radio plant at Montauk Point, Long Island, from which messages were sent by aerial telephony to New York City, then to Wilmington, Del., 200 miles away, and finally to St. Simon's Island, which lies off the coast of Georgia, about 60 miles south by west from Savannah and about 1,000 miles from Montauk Point.

The success of this transmission led the company to secure the cooperation of the Navy Department for the use of the high-power radio station at Arlington for the sending of messages and of other Navy stations for experiments in receiving them. It was agreed on account of the situation with respect to the patent on the device that entire secrecy should be preserved.

In the subsequent experiments the Darien station was the first of the remote stations to receive any of the test messages. The first satisfactory receipt of a message at Darien was on August 27, over a month in advance of the performance of September 29 in which transmission was made from Arlington to San Francisco, and following which the results of the tests were made public. Transmission to Darien, a distance of 2,100 miles from Arlington, was an important step beyond the 1,000-mile communication from Montauk Point to St. Simon's Island and served as a practical assurance that transcontinental radiotelephony was feasible. The talk in the official test on September 29 was not heard by the men at Darien because they were not "listening in" at the time. A message telling them to listen at noon of the 29th had been sent by radiotelegraphy to New Orleans, to be relayed to Darien, but the blowing over of one of the towers of the New Orleans station by the most recent hurricane put that station out of business and delayed the transmission of the message to Darien until after the tests of September 29 were over. However, parts of the transmission of that day were heard by fortuitous listening, and many other messages have been received from time to time. In all the regular tests of transmission to Darien the engineer of the American Telephone and Telegraph

Company stationed at Darien had at least one of the Navy men with him as a witness, in order that his reports might be corroborated officially.

The transmission to Darien was very clear, and frequently the voice from the receiver could be heard at a distance of 25 feet from the instrument. The representative of the company could identify the voices of different ones of his colleagues at Arlington. It would be entirely practicable to connect the receiving instrument at Darien with the Canal Zone telephone system and have the message delivered to any instrument along the line. In the transmission to San Francisco, the president of the company spoke into his ordinary desk telephone in his office in New York and the sound was transmitted by long distance wire directly to the aerial transmitter at Arlington. That wireless telephony works so satisfactorily in connection with wire systems at either end is regarded as of especial importance in making it of commercial service.

One of the sentences heard frequently at Darien was this, or its equivalent: "No, I am not shouting; I am talking in an ordinary voice."

So far in the tests the only transmission has been from Arlington, the other stations being equipped only with receiving apparatus. In the talking to San Francisco, long distance wire connection was provided for return speech, so that conversation was carried on by air in the one direction and by wire in the other. The engineer who was stationed at Darien has returned to the United States, but he left the receiver at the station and the men there occasionally catch transmissions from Arlington if they happen to listen at the right time.

In commenting on the tests, the chief engineer of the American Telephone and Telegraph Company stated that radiotelephony could never take the place of the wire telephone system, on account of the interference to which it is subject from natural and artificial causes, but he thinks it can be of tremendous assistance in communication, especially for reaching remote points not connected with wire systems.

32. Volume IX - November 24, 1915 - Page 117:

Decorative Lily Pond at Darlen Radio Station. A little cove at Darien, formed by the water of Gatun Lake in the hollow between two of the hills on which the radio station is situated, is being planted with water lilies as a part of the horticultural improvement of the reservation. Four exotic varieties have already been established in the lagoon, and about 12 others are under order. Those which have been set out include plants with blue, red, and white flowers. Among the other varieties which

have been ordered are the *Victoria regia*, the lily so liberally noted in geographies under the sections treating of tropical flora by reason of its huge leaf, which, floating on the water, can support the weight of a child; and the lotus, the plant made famous by its reputed Lethean qualities in the Homeric legend of the visit of Ulysses to the Lotophagi. The horticulturist states that, as far as he knows, neither of these plants is now extant in Central America.

A dike across the mouth of the cove with its top a few inches below the surface of the lake protects the lilies against an influx of weeds. The small fish which are in the cove prevent mosquito breeding by destroying the larvae and are protected by the dike against the voracity of the larger lake fish.

Other decorations on the reservation include the planting of rows of hibiscus and oranges along the paths. On the slope opposite the railroad station red-leaved *alternanthera* have been used for a lawn sign, "Darien Radio Station - United States Navy."

33. Volume IX - December 29, 1915 - Page 160:

Keeping Crawling Insects Out of Quarters. In the erection of the frame quarters at the Darien radio station and of quarters transferred to Ancon, as well as some of the new buildings erected at Corozal for the Army forces, special care has been taken to insulate the interiors against the access of ants and other crawling insects so numerous on the Isthmus. The walls of the buildings were supported on short wooden columns, resting on concrete footings, into each of which was built a cup or gutter, two inches wide and 1^{1/2} inches deep, surrounding the entire block. The cups are to be kept filled with larvicide and those on the outside footings are protected by a small projection of concrete, like a pent roof, to keep out the heavy, driving rains which frequently occur. Small metallic cups were installed on the pipes and wires running into the house; these were brought into the house vertically from beneath, and the cups affixed in a horizontal plane.

The arrangement has so far proved fairly effective where the cups are kept filled with larvicide and vegetation not allowed to grow against the house. One company of wood ants gained entrance to one of the buildings at Darien, but it was found that they had come in by means of a clump of grass, which, waving back and forth in the breeze, touched intermittently against the lower edge of one of the walls. When the grass was cut down the ants already in the building, finding their line of communication broken, returned to the spot and dropped to the ground. Other

wood ants, however, having gained entrance, have propagated inside, living in the wood. No other crawling insects give any trouble.

34. Volume IX - January 12, 1916 - Page 173:

STANDARD TIME FOR SHIPS. Chronometers in Port Captains' Offices Are Regulated by Radio from Washington. The chronometers in the offices of the Port Captains at Cristobal and Balboa are being calibrated by checking against the time sent out every day at noon from the chronometer in the United States Naval Observatory at Washington. The time is flashed to the radio station at Darien from that at Key West, which sends it direct from a telegraph wire from the observatory in Washington. The current on the wire from Washington works through a relay and operates the radio sending key. The Darien station transmits the signal by telegraph wire to the Port Captains' offices, as well as to the headquarters of the troops in the Canal Zone, at Ancon.

The time signal is sent from Key West in a series of dots, transmitted at precise intervals. Five minutes before the hour of 12 noon the sending operator begins to count off the seconds by sending a dot at the beginning of each second. After the twenty-eighth dot there is a pause, the twenty-ninth dot being omitted. The count is resumed on the thirtieth second, at the exact half minute, and continued by seconds until the fifty-fourth has been struck. There is then a pause of five seconds, the count being resumed on the sixtieth second. This procedure of counting is kept up for four minutes and 50 seconds, or until 10 seconds before noon. By the time the tenth second preceding 12 o'clock is reached the receiving operator will have his chronometer practically synchronized, but a pause of 10 seconds is made to give clarity and emphasis to the signal for the exact hour. At the exact hour the signal is given by one long dash.

The aerial transmission is recorded at Darien by a current too slight to permit ordinary electrical relaying. Relay connections cannot, therefore, be made to transmit the original signals direct to the offices of the Port Captains. This is handled by having the receiving operator at Darien transmit through an ordinary telegraphic key the signals as he hears them come through his receiver from the antennae. With practice he can strike the dots on his sending key in almost perfect synchronism with the dots received, this being almost mechanical. The principal difficulty is in sending the dash indicating exact noon, as after the pause of 10 seconds it takes a slight interval of time for the operator's brain to register the signal and respond in the pressing of the key. This causes a slight lag, which has been measured and found to vary between two tenths and three-tenths of a second. It can hardly be eliminated,

because if the operator tries to anticipate the receipt of the dash, he is likely to strike the key too soon. However, even with these mechanical defects in the system, it is possible to give slightly more accurate time than can be done over a long cable, in which the capacity causes some retardation. With allowance at the Port Captain's offices for the lag of approximately two-tenths of a second in the sending of the final dash, it is possible to rectify the chronometers to within one-tenth of a second of absolute accuracy. The lag is observed each day at the Darien station and telephoned to the Port Captains' offices, but it cannot be measured exactly. Arrangements are being made for the installation of a transmitting clock at Darien, which will transmit the signals exactly as they come from Key West.

The importance of exact time at the Canal lies principally in its being given to the ships coming to the Canal ports. In making observations of heavenly bodies to determine longitude at sea a variation of a second of time from accuracy means an error of one fourth of a nautical mile in location. Accordingly, if a ship's chronometer were five minutes off from the true time an observation of longitude might result in an error amounting to 75 miles. The time element is of less importance in the calculations of latitude.

The service which is received at the Darien station is part of that furnished to ships at sea through Key West and other radio stations. It is described in a circular, No. 6, published by the Hydrographic Office.

35. Volume IX - March 22, 1916 - Page 273:

Radio Operators. The Radio Officer, Canal Zone, desires to communicate with all American citizens in this vicinity who are amateur or professional radio operators and who might be expected to volunteer their services to the United States Government in the event of war. Address: Lieutenant E. C. Raguet, U. S. N., Naval Radio Station, Darien, C. Z.

36. 35. Volume IX - March 22, 1916 - Page 273:

Lag in Time Signals Received on the Isthmus. The United States Naval Observatory has determined the lag of the Arlington time signal to be about two-hundredths (.02) of a second, and that of the Key West radio signal to be about twenty-seven hundredths (.27) of a second, the latter being due to the various relays in the commercial telegraph lines over which the signal passes from the Naval Observatory. The error of the time signal sent out from the radio stations is generally less than one-tenth (0.1) of a second.

PANAMA RAILROAD COMPANY.

TIME TABLE FOR PASSENGER SERVICE ON JULY 4, 1916.

Supplement No. 1 to Current Time Table No. 23, Effective from 1:25 a. m., Tuesday, July 4, to 2:30 a. m., Wednesday, July 5, Only.

MAIN LINE.

SOUTHWARD.										NORTHWARD.										2d class
FIRST CLASS.								STATIONS.		FIRST CLASS.										
201	123	121	119	117	115	113 *	111			110	112	114	116	*118	120	122	202			
A. M.	P. M.	P. M.	P. M.	P. M.	P. M.	A. M.	A. M.	Leave	Arrive	A. M.	A. M.	P. M.	P. M.	A. M.	A. M.	A. M.				
11:05	9:05	7:10	5:10	3:10	1:10	9:15	7:15	Colon	8:55	10:55	12:45	6:50	10:45	12:45	1:55	10:45				
2:30	11:10	9:10	7:15	5:15	3:15	1:15	9:20	Mount Hope	8:50	10:50	12:40	6:45	10:40	12:40	1:50	10:40				
2:35	11:15	9:15	7:20	5:20	3:20	1:20	9:25	Mindi	8:45	10:45	12:35	6:40	10:35	12:35	1:45	10:37				
2:50	11:20	9:20	7:25	5:25	3:25	1:25	9:30	Gatun	8:40	10:40	12:30	6:35	10:30	12:30	1:40	10:32				
3:02	11:30	9:30	7:35	5:35	3:35	1:30	9:40	Quebrada	8:30	10:30	12:20	6:25	10:20	12:20	1:30	10:15				
3:06	11:35	9:35	7:40	5:40	3:40	1:35	9:45	Monte Lirio	8:25	10:25	12:15	6:20	10:15	12:15	1:25	10:10				
3:10	11:40	9:40	7:45	5:45	3:45	1:40	9:50	Bonito	8:20	10:20	12:10	6:15	10:10	12:10	1:20	10:04				
3:20	11:46	9:46	7:51	5:51	3:51	1:46	9:56	Frijoles	8:14	10:14	12:04	6:09	10:04	12:04	1:14	9:56				
	11:53	9:53	7:58	5:58	3:58	1:53	10:03	Darien	8:07	10:07	11:57	6:02	9:57	11:57	1:07	9:56				
3:30	11:55	9:55	8:00	6:00	4:00	2:00	10:05	Camito	8:05	10:05	11:55	6:00	9:55	11:55	1:05	9:56				
3:42	12:04	10:04	8:09	6:09	4:09	2:09	10:14	Gamboa	7:55	9:55	11:45	5:50	9:45	11:45	1:00	9:56				
4:02	12:15	10:15	8:20	6:20	4:20	2:20	10:30	New Culebra	7:45	9:45	11:35	5:40	9:35	11:35	1:00	9:56				
4:12	12:29	10:29	8:34	6:34	4:34	2:34	10:44	Pedro Miguel Jct	7:33	9:33	11:23	5:28	9:23	11:23	1:00	9:56				
5:05	12:35	10:35	8:40	6:40	4:40	2:40	10:50	Miraflores Lock	7:26	9:26	11:16	5:21	9:16	11:16	1:00	9:56				
	12:39	10:39	8:44	6:44	4:44	2:44	10:54	Coronel	7:21	9:21	11:11	5:16	9:11	11:11	1:00	9:56				
	12:45	10:45	8:50	6:50	4:50	2:50	11:00	Balboa Heights	7:15	9:15	11:05	5:10	9:05	11:05	1:00	9:56				
	12:50	10:50	8:55	6:55	4:55	2:55	11:05	Panama	7:10	9:10	11:00	5:05	9:00	11:00	1:00	9:56				
A. M.	A. M.	P. M.	P. M.	P. M.	P. M.	A. M.	A. M.	Arrive	Leave	A. M.	A. M.	P. M.	P. M.	P. M.	P. M.	A. M.	A. M.			
201	123	121	119	117	115	113	111			110	112	114	116	*118	120	122	202			

*Train No. 118, leaving Panama 9 p. m. for Colon, will make first stop at Gamboa.

PANAMA-LAS CASCADAS BRANCH.

SOUTHWARD.									STATIONS.	NORTHWARD.									
FIRST CLASS.										FIRST CLASS.									
149	147	145	143	141	139	137	135	133		*131	130	132	134	136	138	140	142	144	146	148
A. M.	A. M.	P. M.	P. M.	P. M.	P. M.	P. M.	A. M.	A. M.	A. M.	A. M.	A. M.	A. M.	P. M.	P. M.	P. M.	P. M.	P. M.	A. M.	A. M.
1.35	12.25	10.25	7.15	4.30	1.10	10.50	9.00	7.00		6.35	8.50	10.25	1.00	3.55	7.05	10.20	12.20		A. M.
1.40	12.30	10.30	7.20	4.35	1.15	10.55	9.05	7.05	7.00	6.38	8.40	10.19	12.55	3.48	6.58	10.14	12.14		1.24
1.45	12.35	10.35	7.25	4.40	1.20	11.00	9.10	7.10	7.02	6.35	8.39	10.14	12.50	3.43	6.53	10.09	12.09		1.19
2.00	12.50	10.50	7.40	4.55	1.35	11.15	9.25	7.25	7.05	6.22	8.27	9.58	12.36	3.29	6.38	9.54	11.54		1.04
2.03	12.53	10.53	7.43	4.58	1.38	11.18	9.28	7.28	7.16	6.19	8.20	9.55	12.33	3.26	6.35	9.51	11.51		1.01
2.09	12.59	10.59	7.49	5.04	1.44	11.24	9.34	7.34	7.20	6.15	8.14	9.49	12.26	3.20	6.29	9.45	11.45		1.05
2.13	1.03	11.03	7.54	5.09	1.49	11.29	9.39	7.39	7.24	6.11	8.10	9.45	12.21	3.16	6.25	9.40	11.40		1.01
2.20	1.10	11.10	8.01	5.16	1.55	11.35	9.45	7.45	7.30	6.05	8.05	9.40	12.15	3.10	6.19	9.35	11.35		1.00
2.25	1.15	11.15	8.05	5.20	1.59	11.40	9.51	7.51	7.35	6.00	8.00	9.35	12.10	3.05	6.10	9.30	11.30		1.00
A. M.	A. M.	P. M.	P. M.	P. M.	P. M.	P. M.	A. M.	A. M.	A. M.	A. M.	A. M.	A. M.	P. M.	P. M.	P. M.	P. M.	P. M.	A. M.	A. M.
149	147	145	143	141	139	137	135	133	*131	130	132	134	136	138	140	142	144	146	148

*Train No. 131, leaving Empire 7 a. m., carrying soldiers only, who participate in exercises.

Main line trains will wait at Pedro Miguel for connections from Las Cascadas branch trains; and Las Cascadas branch trains will wait for connections from main line trains, unless otherwise instructed.

Subscription Lists in Campaign for Members for Red Cross.

Of the Red Cross subscription lists which have been sent out among the departments and divisions of the Canal organization in the campaign for increased membership, several have not been returned. The secretary of the Canal Zone chapter requests that they be returned to him at Balboa Heights for accounting purposes; but if there are prospects for more members the lists may be retained a little longer.

The bureau of membership of the central organization of the American Red Cross has issued a circular stating that on account of the great increase in members resulting from the campaign there has been difficulty in keeping up to date the entries for subscription to the Red Cross Magazine, which is sent to every member; and that this will account for the delay, if new members should not receive the magazine the first month after joining.

OFFICIAL CIRCULARS.

Charges for Electric Current.

THE PANAMA CANAL.

EXECUTIVE OFFICE.

BALBOA HEIGHTS, C. Z., June 12, 1916.

CIRCULAR No. 676-8:

The rate for electric current furnished to individuals (nonemployees) and companies in the Canal Zone, and

to employees of The Panama Canal and Panama Railroad Company for commercial use, as prescribed in Circular 676-5, is hereby amended, effective July 1, 1916, as follows:

CURRENT CONSUMPTION IN ONE MONTH.		Per kilowatt-hour.
First 100 kilowatt-hours.....		\$.08
Next 200 kilowatt-hours.....		.06
Over 300 kilowatt-hours.....		.04

CHESTER HARDING,

Acting Governor.

Classification of Survey Requests.

THE PANAMA CANAL.

EXECUTIVE OFFICE.

BALBOA HEIGHTS, C. Z., June 9, 1916.

CIRCULAR No. 638-1:

1. In future, separate survey requests will be submitted to the Surveying Officer, covering the following classes of property, and no request will cover more than one class:

- China and glassware for subsistence use.
- Linen for subsistence, hotel, and hospital use.
- Plant items.
- Miscellaneous items, other than above.

2. All survey requests will be arranged alphabetically and where practicable, items of property must be laid out for inspection by the Surveying Officer, in the same order that they appear on the survey requests.

CHESTER HARDING,

Acting Governor.

Tickets for Trains on Fourth of July.

THE PANAMA CANAL.

EXECUTIVE DEPARTMENT.

BALBOA HEIGHTS, C. Z., June 12, 1916.

To all concerned—1. No employees' 24-trip tickets nor regular complimentary passes of any kind will be

honored on Panama Railroad trains on July 4, except those which may be presented by officials of the Republic of Panama or a foreign country.

2. Enlisted men of the Army or Navy, in uniform, will not be required to present any form of transportation, but one of the following forms will be necessary for the passage of other persons:

- (a) Regular railroad tickets or mileage.
- (b) Fourth of July tickets, to which those who contributed to the celebration are entitled.
- (c) Official business trip passes.
- (d) 120-trip tickets, books stamped "Good on Sundays or holidays."

3. This notice is published sufficiently in advance to enable persons traveling on official business on July 4 to avail themselves of official business trip passes.

4. A schedule for the operation of trains on July 4 will be issued later.

CHESTER HARDING,

Acting Governor, The Panama Canal,

Second Vice President, Panama Railroad Co.

Annual Report.

THE PANAMA CANAL.

EXECUTIVE DEPARTMENT.

BALBOA HEIGHTS, C. Z., June 13, 1916.

HEADS OF DEPARTMENTS AND DIVISIONS:

It is desired that annual reports for the fiscal year ending June 30, 1916, be submitted to this office not later than August 1, 1916.

The reports will be prepared in quintuplicate, on the same size and grade paper as that used for previous annual reports, namely, six by 14 inches. Reports will be submitted to the Governor by heads of departments and divisions covering the work under their jurisdiction, as follows: The Engineer of Maintenance; the Marine Superintendent; the Resident Engineer, Dredging Division; the Superintendent of the Mechanical Division; the Resident Engineer, Building Division; the

The radio station at Darien receives the time signal from the Key West station and transmits it by wire telegraph to the offices of the Port Captains. In this there is a lag of about two-tenths of a second, but by calculating on this it is possible to give the Port Captains time within one-tenth of a second of synchronism with the signals from Key West. Assuming a maximum variation in the Key West signal of one-tenth of a second from the standard determined in the Naval Observatory, the cumulative error at the Port Captains' offices will hardly exceed two tenths of a second. Assuming that this error is constant from day to day, the rate of a chronometer can be obtained with a very high degree of accuracy.

37. Volume IX - August 2, 1916 - Page 424:

Additional Passenger Accommodations. Effective August 1, 1916, the Panama Railroad will inaugurate a mixed train service from Colon to Panama, handling through freight and first-class passengers. This train will be operated on the following schedule, daily except Saturday:

Leave Cristobal commissary. . . 11.00 p. m.

Mount Hope 11.05 p.m.

Gatun 11.20 p. m.

Monte Lirio 11.35 p. m.

Frijoles 11.46 p. m.

Darien 11.53 p. m.

Gamboa 12.04 a. m.

New Culebra 12.15 a.m.

Pedro Miguel Junction 12.29 a. m.

Miraflores Locks 12.35 a. m.

Corozal 12.39 a. m.

Balboa Heights 12.45 a. m.

Panama 12.50 a. m.

All forms of first-class transportation now in use will be accepted on this train, and there will be no excess charge on cash fares collected.

This service consists essentially of the attachment of a first-class coach to the through freight train which is sent across every night. It is designed primarily for the convenience of residents of Gatun who wish to spend the evening in Colon. No way freight will be handled on this train.

38. Volume X - February 28, 1917 - Page 353:

Notice to Mariners - Radio Time Signals.

The Panama Canal, Balboa Heights, C. Z., February 21, 1917.

Circular No. 643-35:

1. There has been installed by the Navy Department, at the Darien Radio Station. Canal Zone, a time transmitting clock so constructed as to send time signals by radio. The clock is adjusted daily to Washington Observatory time by radio signal, with a maximum error not to exceed five-tenths of a second, ordinarily not to exceed one-tenth of a second. The signal is sent out by radio each day at 1.00 p. m., 75th meridian time. This signal begins at 12.55 p. m. and continues for five minutes. During this interval every tick of the clock is transmitted by radio except the 29th second of each minute, the 55th to the 59th second of each of the first four minutes, and finally the 50th to the 59th second of the last minute. The 1.00 p. m. signal is a longer contact after the longer break. The wavelength used is 4,000 meters and is sent out so that any ship with ordinary commercial receiving apparatus capable of tuning as high as 4,000 meters should be able to receive it.

2. As the Navy Department of the United States has spared no expense in making the service reliable, it is desired that maximum benefits will result to shipping, and it is hoped that ship captains will communicate with the radio office at Darien, either by letter or radio, giving data as to distance of reception, clearness of signal, etc., in order that the service may be improved. If it is found that many merchant ships cannot tune to the 4,000 meters wavelength, arrangements will be made to send time simultaneously from Colon Radio Station on a spark transmitter with shorter wavelength.

Chester Harding, Governor.

39. Volume XV - October 5, 1921 - Page 129:

The Radio System on the Isthmus. The system of radio communication operated by the Navy Department on the Isthmus contains 7 stations. The only other commercial station on the Isthmus is that of the United Fruit Company at Almirante, which has been specifically licensed to operate. The laws of Panama and the Canal Zone restrict radio operations to the control of the United States.

The Navy stations consist of the high-power station at Darien; the stations at Balboa and Colon, at the two ends of the Canal; a station at Coco Solo, primarily for naval

use in local operations; and 3 outlying stations - at Punta Mala, on the western side of the entrance to the Gulf of Panama; at La Palma, diagonally opposite, on the Bay of San Miguel; and at Puerto Obaldia, on the Atlantic coast, about 2 miles from the border of Colombia.

In present practice the Darien and Balboa stations are operated together, practically as one station. Messages are received at Balboa, but not at Darien; and all sending from Balboa is done through the Darien station. Outgoing messages are telegraphed from Balboa by land wire to Darien, where the electric impulses, operating through solenoid devices, actuate the transmitting mechanism. The three 600-foot towers at Darien carry 3 sets of antennae. One set is for the "big arc" transmission to Arlington station, near Washington, to San Diego, and for other long-distance service; the other sets are "spark" antennae, for local use and messages to ships as close as 1,000 miles.

San Diego is about 3,000 miles, by air, from Darien, and this distance may be accepted as Darien's regular and reliable sending range. Instances have been recorded, however, of the station's having been heard at a station in Australia, over 7,000 miles away, and by a ship at sea passing from Colombo to Aden, practically on the opposite side of the world and approximately 12,000 miles away (the steamship M. S. Dollar, January 21, 1921). The station has heard messages sent out from Nauen, near Berlin, San Francisco, Honolulu, and other remote points; but the range from which messages may be received is a function of the other station's transmitting power rather than of the capacity of the receiving station.

The stations at Balboa and Colon handle most of the communication with ships. The Balboa station works primarily with ships on the Pacific side, receiving their messages on the Balboa antenna and transmitting communications to them through Darien. As a rule, communication with vessels outside the Gulf of Panama is handled through the Punta Mala station; communication between the Cape Mala and Balboa stations is by either land telegraph or radio.

The Colon station works with ships on the Atlantic side, and normally communicates with them directly throughout the Caribbean area.

The Balboa station handles about 12,000 words of commercial traffic per month, Colon about 11,000, and Punta Mala about 3,500. The messages average about 15 words each. No commercial traffic is handled by the Navy radio stations between the Isthmus and points in the United States. Such business is handled by the cable

lines, with the exception of the company's business handled by the United Fruit Company's station at Almirante.

The bulk of the commercial business through the Navy stations is messages between steamship agents and vessels, or between the vessels and the Port Captains, with some personal messages to or from passengers. The service is available, however, for the transmission of communications between the Isthmus and points in Panama, Colombia, Ecuador, and Venezuela, to the south, and to Costa Rica, in the opposite direction.

The outlying stations at La Palma and Puerto Obaldia afford the only means of quick communication with the sections of Panama adjacent to them, as there are no telegraph or telephone lines extending into those areas from the capital. That part of the Isthmus, roughly designated as "the Darien region," is very slightly developed. On the Punta Mala side of the Gulf the telegraph lines of the Republic of Panama reach all the principal towns.

La Palma and Punta Mala stations are about 100 miles from Balboa, and the Puerto Obaldia station is about 180 miles from Cristobal. Each is in charge of an electrician, with the necessary operators for the regular watches. A tug goes from the Canal to each station once a month, carrying supplies and mail. In practice, operators are not allowed to serve at one of the outlying stations for more than a year at a time, because in the environment of easy service, tropical surroundings, and absence of routine discipline they usually grow slack, hence in justice to the men and to the service they are not allowed to stay too long.

The oldest of the stations in point of service is that at Colon. Authority for the erection of the original station was issued in the latter part of 1904, and the station was established the following year. A new apparatus was installed in 1910. The station was opened to the handling of commercial business in January 1913. In 1914 was begun the erection of the present station, which was completed in 1915. Improved equipment was installed, and the 280-foot vertical masts were supplanted by the present 300-foot pyramidal towers, spaced 600 feet apart.

A small station at Porto Bello was opened on December 31, 1909, and used through the construction period for the transmission of messages, by way of Colon, between Porto Bello and the administrative headquarters on the Canal Zone. The Porto Bello station was approximately 17 miles from Colon. It used a 520-foot circle aerial mounted on a 150-foot mast. The station was operated until May 13, 1914, when American operations at the place were discontinued and the station was closed.

The original Balboa station was erected at the foot of Sosa Hill, in the early part of 1913, and was opened to commercial business in June of that year. It used one 110-foot mast and the smokestack of the old electrical plant at Balboa for the support of the aerial and had a normal sending radius of 200 miles. In 1915 it was supplanted by the present station, adjoining Fort Amador. The present station, like that at Colon, has its aerial supported on two 300-foot towers, 600 feet apart, and has a normal sending radius of 500 miles.

The Darien station is situated alongside the Canal at a point almost exactly midway between the Atlantic and the Pacific. Its erection was begun on July 9, 1914, and was completed the following May, although the handling of Government messages through the station had begun on April 5, 1915. The Darien station is, in general, like that at Arlington, Va., a 100-kilowatt plant with a normal sending radius of 3,000 miles. The aerials are carried on three 600-foot pyramidal towers, standing at the points of an equilateral triangle, 900 feet on the side. With its normal range the station can communicate to San Francisco, to a point 400 miles south of Valparaiso, to Buenos Aires, or to St. Vincent, about 500 miles west of the coast of Africa.

Of the outlying stations, Punta Mala was placed in operation in May 1919. The La Palma station was opened in July 1919, and that at Puerto Obaldia in January 1920. The outlying stations carry their antennae on two 200-foot masts, 300 feet apart, and have a normal sending radius of approximately 200 miles.

40. Volume XX - September 8, 1926 - Page 75:

Supplement No. 3 to Rules and Regulations Governing Navigation of the Panama Canal and Adjacent Waters. The Panama Canal, Executive Office, Balboa Heights, C. Z., September 3, 1926. Regulation 174.1 is amended to read below: H. Burgess, Acting Governor.

(Note - This regulation should be inserted in Chapter XIII, page 59, of "Rules and Regulations Governing Navigation of the Panama Canal and Adjacent Waters," 1925 edition.)

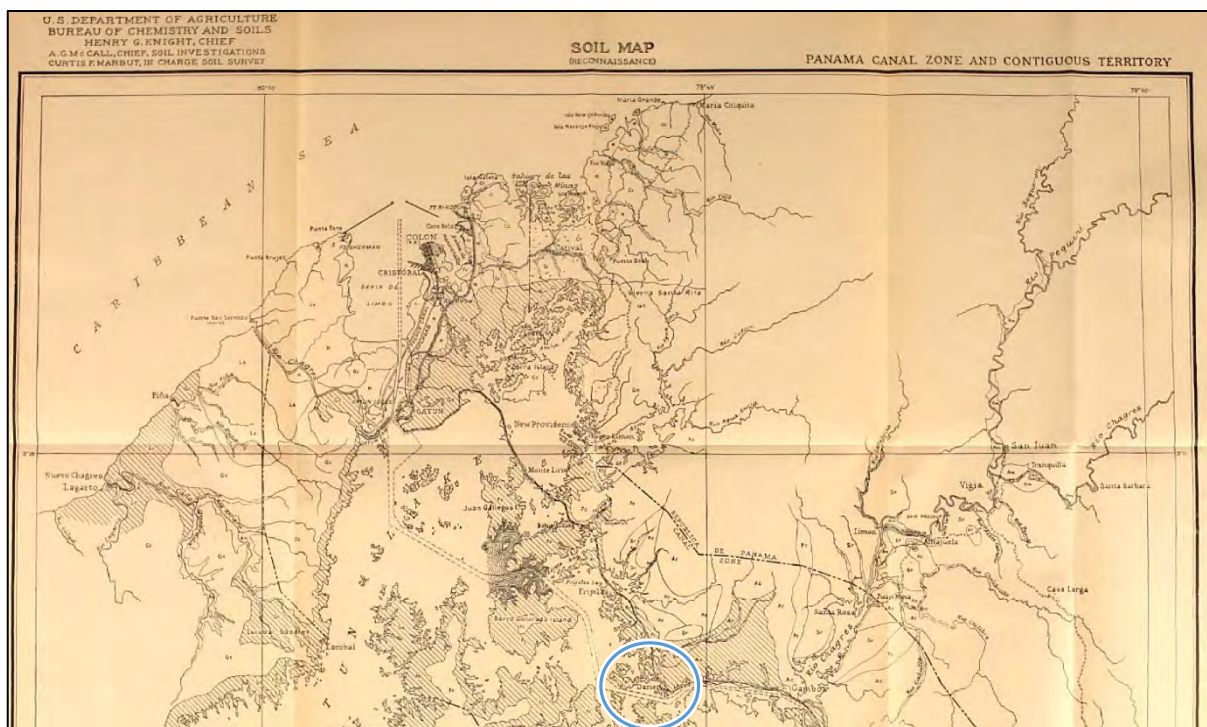
Regulation 174.1 Routing of Messages: Messages may be sent to either Colon or Balboa Radio stations by ships approaching the Panama Canal or in Canal Zone waters, preference being given to the nearer station. The high-power station at Darien will not handle commercial work. Ships in the Pacific more than 50 miles from Balboa will communicate with Cape Mala Radio station, from which station messages are relayed to the Canal Zone or Republic of Panama by telegraph.

41. Volume XXII - April 17, 1929 - Page 521:

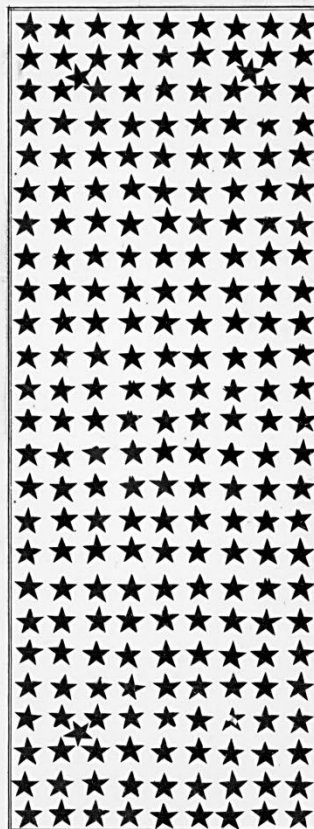
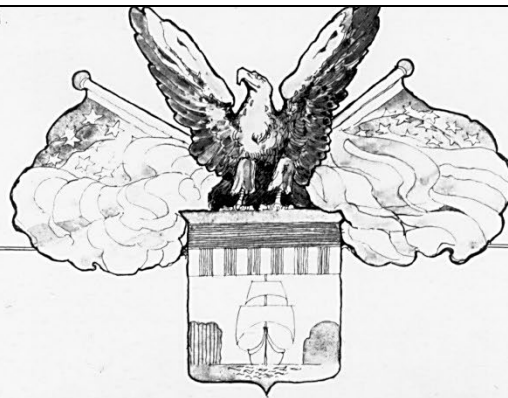
Removal of Colon Radio Station. The work of removing the Colon Radio Station from Colon Beach, in the section known as "New Cristobal," to another location was begun in February 1929, in order that the land may be utilized for building sites in the program of construction of quarters started by The Panama Canal about two years ago. The new radio station will be located north of Fort Davis. The towers will be 200 feet high instead of 300 feet, the height of the Colon towers. The Communication Superintendent for the 15th Naval District advises that, beginning April 9, and continuing until the new site is completed, the Colon Radio Station is using temporary receiving antennae with remote control to a transmitter in the Darien Station which emits a CW wave.

In another part of this issue appears a "Notice to Mariners," in which it is stated that in the future night lights will not be displayed on the towers at the Colon Radio Station, due to dismantling of the towers.

1929 PANAMA CANAL ZONE AND CONTIGUOUS TERRITORY - DARIEN RADIO STATION



ROBERT S. CARLSON.
WILLIAM A. STEVENSON.
FRANK H. WANG.
MERTON M. OGDEN.
OMER E. MALSBUY.
IVOR VAUGHAN JONES.
JOSEPHUS C. FRIDDLE.
GEORGE W. GREEN.
WILLIAM A. GRAY.
RALPH H. SARTOR.
HAROLD M. SCHMECK.
JOHN C. KJERNAN.
RALPH Z. KIRKPATRICK.
WALTER DE L. HUBBARD.
IVAN E. HIX.
JOHN G. BARBER.
REV. HENRY COLLINS.
GUY B. BYAM.
LEANDER LARSON.
WILLIE B. GIST.
RALPH OSBORN.
FRANK A. QUIGG.
W. JAY PLANK.
JOHN C. SCOTT.
EDWIN D. MASON.
WILLIAM M. QUINN.
DORON NORTON, JR.
JOSEPH E. NEIL.
HAROLD A. TODD.
WILLIAM H. STONE.
MARK A. MARTIN.
CARL W. MARKHAM.
FREDERICK DE V. SILL.
JOHN J. SEXTON.
JOSEPH F. SNOOK.
DUNHAM W. NORTON.
ALEXANDER E. MEIGS.
WILLIAM H. NEEDHAM.
NATHANIEL J. OWEN.
EDWARD J. TUCKER.
ELBERT S. WAID.
WILLIAM P. SMITH.
ANCE S. BARDEN.
MARTIN ALLGEIER.
LAWRENCE H. DUNN.
ALBERT R. MORRELL.
JOHN E. LEFEVER.
NORRIS E. DREW.
ARTHUR G. BERUDE.
CHESTER B. JOHNSON.
PEARL R. KIGER.
JAMES R. LARCOMBE.
GEORGE D. HOLDEN.
RALPH L. GESNER.
LAWRENCE E. FUENTES.
ANDREW G. HILL.
ALLEN J. KISNER.
RUSSELL R. HAND.
THOMAS Q. COSTELLO.
EDWARD P. BEVERLEY.
GRAHAM P. BROTHESON.
JOSEPH H. LINDSEY.
ROBERT L. MITCHELL.
JOHN M. KEOUGH.
HORACE C. BROWN.
HAROLD F. CRADDOCK.
LARENCE E. ANSBERRY.
STEPHEN BYRNE.
HARRY C. BOWERS.
ERNEST BEHLEN.
GEORGE L. COPE.
ROBERT W. HUTCHINGS, JR.
HARRY C. HIMES.
LOUIS F. HULCHER.
CYRUS G. HODGE.
CLYDE W. HUBLEY.
WALTER JACKSON.
JOHN KENNEDY.
JOHN LOGAN.
AMES J. LOUGHNEY.
WALTER E. O'CONNELL.
PAUL G. POMEROY.
JUNNINGHAM PATTERSON.
JOHN J. ROSE.
DOSTER B. STEWART.
MARTIN J. CAIN.
RICHARD L. HAYS.
JOHN C. DEAVOURS.
ELAND A. REINHOLD.
CLARA J. SIMPSON.
LEO WELING.
LOUIS PEARSON.
EITH E. KELLEY.
WILLIAM A. ANDRESEN.
JOSEPH N. PARROTT.
RAYMOND L. BURMESTER.
ANTHONY F. RAYMOND.
ALBA D. HUTCHINGS.
VESPER C. DILLON.
P. N. FONTENELLE.
JAMES S. WHITEHORNE.
JOHN E. STOFFELL.
ANTON J. FIRTIK.
WALTER R. SMITH.
JEROME F. PRAGER.
CARL A. STROM.
ELMER STETLER.
FRANK MACK.
JAMES T. EASON, JR.
JOHN M. DAVIES.
EDWARD A. WIGHT.
EUSTACE W. MINGEE.
G. ARTHUR HOWARD.
GEORGE W. PENDLETON.
FREDERIC L. NEILSON.
JAMES W. SHERRILL.
WILLIAM A. DAY.
CHARLES F. YOUNG.
JAMES L. HADAWAY.
MAURICE SCHOTLAND.
MILO C. PRATT.
WILLIAM G. NAYLOR.
ROBERT H. CERISE.
MARGARET E. MADDOX.
THEODORE M. DRAKE.
MORTIMER H. FRENCH.
WILLIAM F. LISK.
ALBERT M. HORTLE.
WILLIAM LUNDSTROM.
JOHN STRASSER.



HERBERT C. CLARK.
WILLIAM B. FOSTER.
CHARLES P. CULLEN.
SHERMAN C. ABERNATHY.
FRANK D. CHISHOLM.
GEORGE S. FOWLER.
AUGUST P. GOMPF.
HENRY G. KELLY.
LAWRENCE C. HOWARD.
BERNARD W. MCINTYRE.
JOHN M. O'ROURKE, JR.
BERNARD E. MCKEEVER.
SAMUEL A. WHITEHURST.
CLARENCE E. SHERWOOD.
ARTHUR H. SOPER.
KURT W. RUFF.
CHARLES H. MANN.
HERBERT PEARSON.
JAMES E. JACOBS.
MARCOS FREEMAN.
ARTHUR B. KRATZ.
ALFRED PAULSEN.
FRANK MORTON.
TONY J. ODENS.
FRED E. NEHLS.
PERCE T. MURPHY.
OLIVER J. MASON.
ARMAND C. WOOD.
LOUIS C. WERNER.
JOHN B. PATRICK.
RICHARD T. PERROTT.
LOUIS A. POLTRINO.
MITCHELL SMILEY.
ROBERT R. ROSS.
JOHN STEMSKI.
MALCOLM R. WHEELER.
DAVID W. NEVINS.
CARLTON G. ARCHIBALD.
LORRAINE ANDERSON.
WILLIAM L. FEY.
THOMAS H. CHAMBER.
JOHN O. FISHER.
FRANK C. DE GRACE.
WILLIAM E. DOBSON.
THORWALD H. FORSTROM.
CLINTON A. DUFF.
MARTIN R. CUFF.
EDWARD N. JERRY.
HAROLD C. JENKINS.
PATRICK F. RYAN.
RYLAND G. TAYLOR.
BASIL C. RECHER.
JAMES MCKEOWN.
JOHN B. CORLISS.
GEORGE A. DOWNEY.
ROBERT J. VOORHEES.
VERN D. CALLOWAY.
WALLACE B. AMES.
HENRY R. CLEMENTS.
FRANK A. BITTERLE.
THOMAS A. LEATHLEY.
CURTIS W. LEGETTE.
MEARL J. TUTTLE.
CHARLES W. STEWART.
OTTO F. SONNEMAN.
JEROME W. MILLER.
DANIEL W. MACCORMAC.
THOMAS MCCABE.
CHARLES F. GARDNER.
CURTISS L. HEALD.
JAMES J. HOLCOMB.
CARL A. HODGDON.
FRANK DELLATORRE.
CARL W. CONNELL.
RAY W. BERDEAU.
GEORGE L. DAVISON.
HOWARD J. DOHRMAN.
MANUEL P. ARRUDA.
ADRIAN M. BUTCHER.
CHALLISS C. CARR.
RICHARD E. KNAPP.
EDMUND L. KOPERSKI.
EUGENE L. HOLLIS.
JAMES A. LANGSTON.
HUGH T. JOHNSTON.
ADAM J. HOFMANN.
CLIFFORD D. HINDLE.
CARL M. LUTZ.
EDWARD J. MULLI.
ROBERT I. BARNES.
ALBERT VAN ZANDT.
ALFRED F. MORRIS.
GILLIAM SESSOMS.
WILLIAM B. GODFREY.
KENNETH B. LEE.
JAMES T. EASON, JR.
JOHN M. DAVIES.
FREDERIC L. NEILSON.
MAURICE SCHOTLAND.
THEODORE M. DRAKE.
JOHN STRASSER.

VI. World War I (July 28, 1914 - November 11, 1918)⁴

During World War I, radio communications played a crucial role in the operations of the Panama Canal for several reasons:

Naval Coordination: Radio allowed for effective communication between the Canal Zone authorities and naval vessels transiting through or stationed in the area. This was vital for coordinating naval movements, especially during wartime when naval presence and movements needed careful monitoring and control.

Security and Surveillance: Radio communications enabled continuous monitoring of the Canal Zone and its surroundings. It facilitated early detection of any potential threats or suspicious activities, allowing for swift response measures to be taken.

Logistics and Supply: Radio facilitated efficient logistics and supply chain management within the Canal Zone. It allowed for real-time communication regarding the status of shipments, the availability of resources, and the coordination of military and civilian activities.

Emergency Response: In case of emergencies such as accidents, natural disasters, or security breaches, radio communications provided a reliable means for coordinating rescue and response efforts promptly.

Intelligence Gathering: Radio intercepts and communications provided valuable intelligence about enemy activities and intentions in the region. This intelligence was critical for military strategists to plan defensive and offensive operations effectively.

Overall, radio communications were indispensable during World War I in the Panama Canal Zone, ensuring the smooth operation of the canal and contributing significantly to the Allied war effort in the Atlantic and Pacific theaters.

⁴ IBID

SIXTY-SIXTH

ANNUAL REPORT OF THE
BOARD OF DIRECTORS

OF THE

PANAMA RAIL ROAD COMPANY

TO THE STOCKHOLDERS
FOR THE YEAR ENDING JUNE 30, 1915

M. B. BROWN PRINTING & BINDING CO.,
37-41 CHAMBERS STREET, NEW YORK

VII. Panama Railroad Company Annual Report (1915)

The construction of the underground Trans-Isthmian conduit line and the installation of the new fifty-pair cable therein, which enabled the existing overheadlines to be removed, together with the shifting of the telephone load from the Empire-Culebra District to Balboa, necessitated an entire rehabilitation of the telephone system and a general re-arrangement of the central offices.

To give temporary service during the period of moves and changes, the PBX-Boards at Empire, Empire Shops, Gorgona Shops and several other points were abolished, and centrals established at Balboa and Balboa Shops. A new nine-position switchboard was installed in the Administration Building, Balboa Heights, and upon its completion, the centrals at Ancon, Balboa, Balboa Shops, Corozal, Ancon Administration Building and Culebra were abolished and the entire telephone load for this territory concentrated in the Balboa Heights Central Office. In addition to this, centrals at Toro Point, Mount Hope and Porto Bello were abolished and PBX-Boards established at Coco Solo Point and Paraiso.

The four permanent central offices are now located at Balboa Heights, Pedro Miguel, Gatun and Cristobal, with a secondary central at Empire and PBX-Boards at the Governor's Office, Naos Island, Hotel Tivoli, Ancon Hospital, Paraiso and Coco Solo. Trunk service is furnished for outside switchboards at Toro Point, Hotel Washington, Camp Otis, Darien Radio Station, Balboa Radio Station, Colon Radio Station, Gatun Locks, Pedro Miguel Locks, Miraflores Locks and the United Fruit Company's Office in Cristobal.

Construction work was in progress at the- beginning of the fiscal year on the Trans-Isthmian underground conduit line for telephone and signal cables. The final plans called for an eight-way conduit between the Panama Railroad Station, Colon and the Mount Hope Pumping Station, four-way from Mount Hope to Corozal and eight-way from Corozal to Balboa. The total length of the line is approximately 46.5 miles of which 3.9 miles are eight-way and the remainder four-way. There are seven hundred and seventy-seven manholes in the entire line.



ERNEST "RED" HALLEN (1875-1947)

VIII. Then (1914-1926) by Ernest “Red” Hallen

Born in Atlanta, Georgia, in 1875, noted for his 30 years of work in the Panama Canal (1907-1937). After spending six years in Puerto Rico and two years in Cuba, he was appointed as the official photographer of the Panama Canal by the Isthmian Canal Commission in 1907. Hallen was contracted to capture “... a series of photographs... about once a month... to show construction progress” to satisfy both Washington and the American public. In addition to showing the construction and progress of the Panama Canal, Hallen depicted the day-to-day life of the “Zonians” - Americans living in the Panama Canal Zone - and its development over the course of the years. Throughout his 30-year career, Hallen produced between 12,000 and 16,000 images, each with a “strangely satisfying aesthetic experience” portraying life in the Panama Canal Zone.

For his service to the Panama Canal Zone and as an employee of the Isthmian Canal Commission, Hallen was awarded the Roosevelt Medal with two bars. Hallen retired as the official photographer of the Panama Canal Zone in 1937. He and his wife Maude then moved to Monterey Park, California. Died in 1947 at the age of 72.

Hallen's works are the result of a brief memorandum written by F. B. Maltby, Division Engineer of the Isthmian Canal Commission. It is doubtful that he realized the magnitude of this photographic project when he wrote in 1906: "I should like very much to have a series of photographs taken at Gatun about once a month to show the progress of the work. This should be done regularly and will become valuable. I think, in connection with progress reports. I, therefore, request authority for the employment of a photographer, with whom, I understand, arrangements have already been made, not to exceed two days in each month." Subsequently, Hallen was hired as the official photographer and for the next 30 years he went about his duties of recording the progress of the construction and operation of the Canal.

His work is particularly remarkable when it is realized that each of these photographs were taken on the old 8x10 glass plates. He is especially to be commended for the high technical quality of his work considering the cumbersome plates, camera, and other equipment he had to carry to the muddy construction sites while coping with tropical rains and high humidity.

Hallen attempts no personal artistic statements about the Canal but worked at carrying out his assignment-making a documentary record of the construction and later the operation of the waterway. However, the triumphs and setbacks are recorded so proficiently that, on viewing his photographs, one is immediately aware of the immense engineering problems involved in the digging of the Canal. N. F. Karlins writing in the photography column in the New York East Side Express said: "Looking at these photographs today, they are compelling statements about the manipulation of rock, sand, and water over time. Hallen's photographs more vividly reveal the immensity of the project and the difficulties involved in constructing the Panama Canal when they focus on one area and are viewed sequentially.

The transformation of the environment becomes a magical process in which mountains are moved and mammoth trenches cut. "Not only does the principal trench, Culebra Cut, appear closer and closer to completion in these photographs, but workers cottages suddenly pop up as if they had blossomed overnight. In the last photo, just as man has succeeded in cutting a huge swath in the earth, nature has succeeded in reclaiming some of her own land by sending up huge palms before the worker's homes. Progress on the excavation is counter- balanced by the growth of natural vegetation, and they are captured together by Hallen's camera. The processes, not just the object involved, are made visible.

Gene Thornton, writing of the exhibit in his column in the New York Times, said: "They are unpretentious record shots but because of the subject matter some of them are quite bizarre. Without looking at the labels, we might suppose they depict the archeological excavation of ancient masonry walls or the construction of a set for a colossal science fiction film. However, every photograph is clearly labeled and dated on the negative itself, so we are never in any real doubt about what we are seeing or about the photographer's intention to show it to us as clearly and truly as possible."

Only a few of the thousands of Hallen's photographs are reproduced here [Series 60-X / Darien Radio Station]. They serve as a reminder that except for "Red" Hallen or some photographer like him to go out every day and simply take pictures, the heroic drama of the building of the Panama Canal could never have been told in such vivid and precise detail.



60 x 5 Darien Radio Station. Excavation at tower #3 looking toward tower #2. March 16, 1914.



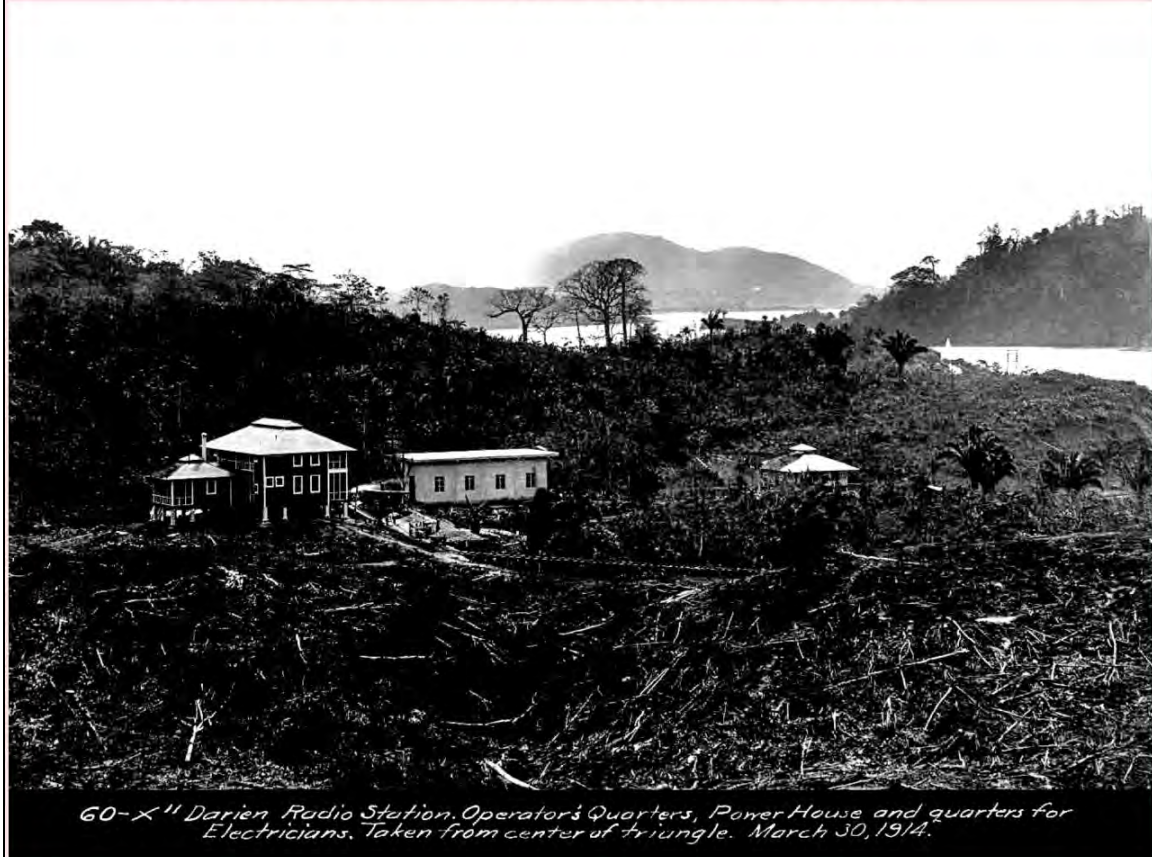
60-x 7 Darien Radio Station. Tower #3 and clearing, from center of triangle. Mar. 30, '14

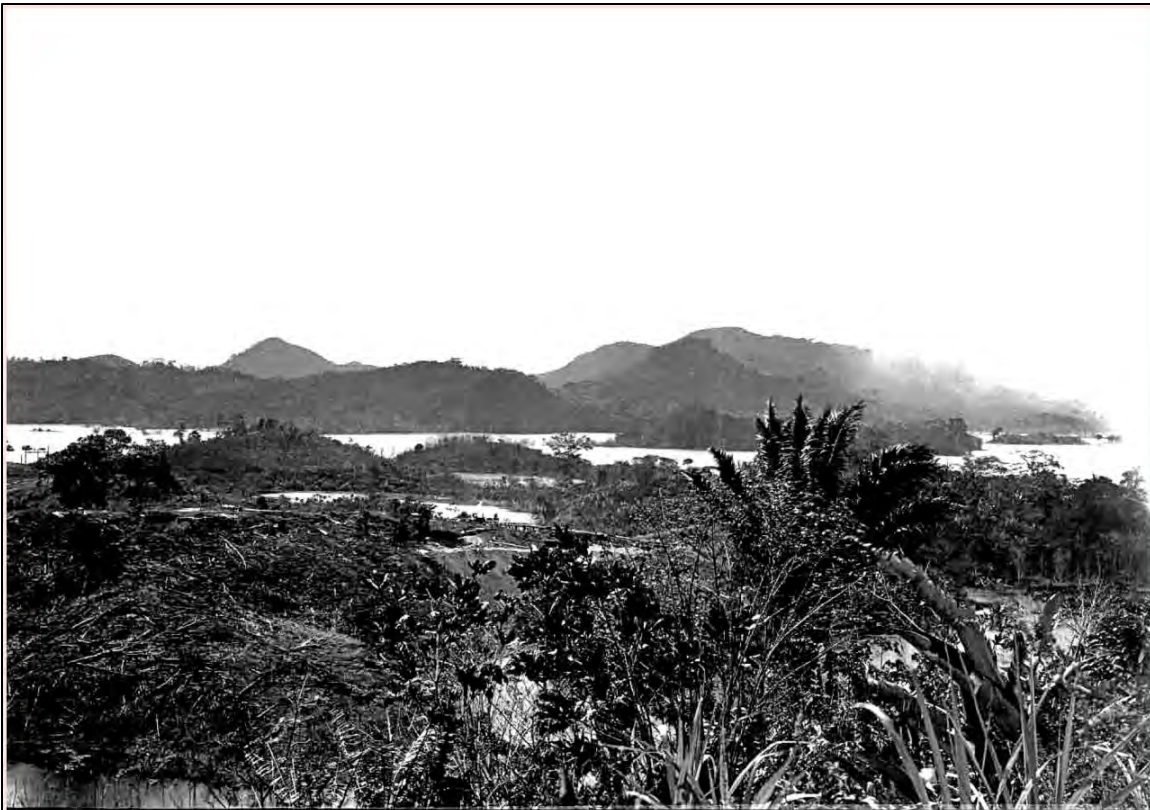


60-X⁸ Darien Radio Station. Operators Quarters, Mixing plant and Power House.
March 30, 1914.



60-X⁹ Darien Radio Station. Quarters for Chief Electrician Mar 30, 1914.





60-X¹² Darien Radio Station Tower #1 and clearing, from hill west of Tower #2. Mar. 30, 14.



60-X¹⁶ Darien Radio Station. Completed concrete work, leg "C", Tower #3. May 1, 1914.



60 x 5 Darien Radio Station. Excavation at tower #3 looking toward tower #2. March 16, 1914.



60-x 7 Darien Radio Station. Tower #3 and clearing, from center of triangle. Mar. 30, 14



60-x 18 Durien Radio Station. Grading for drainage, legs B&C, tower #1. May 1, 1914.



67-X¹⁹ Darien Radio Station. Site cleared and partly burned. Toward Tower #3 May 1, 1914



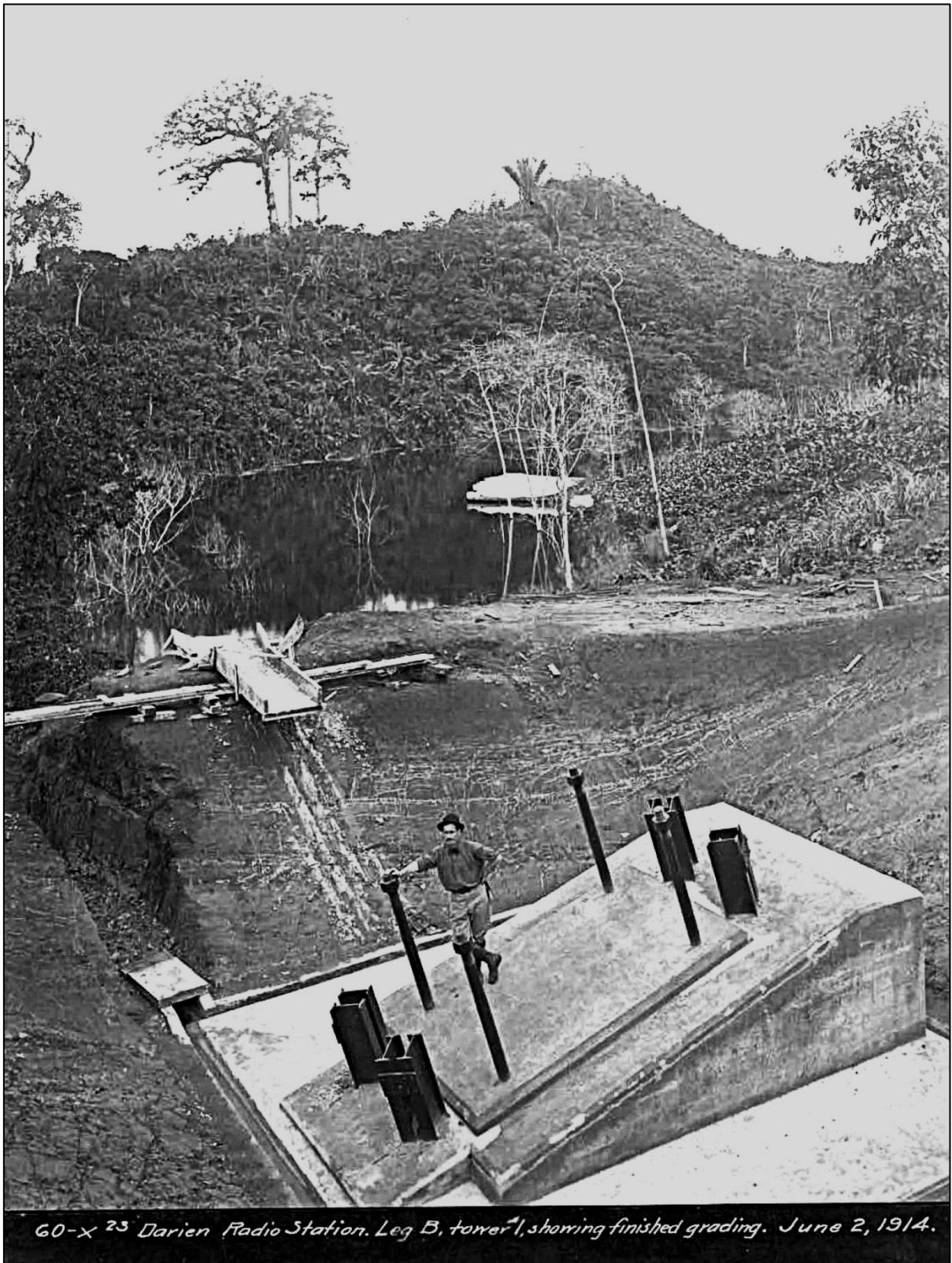
60-X²⁰ Darien Radio Station. Steep bank around leg B, tower #2 June 2, 1914.

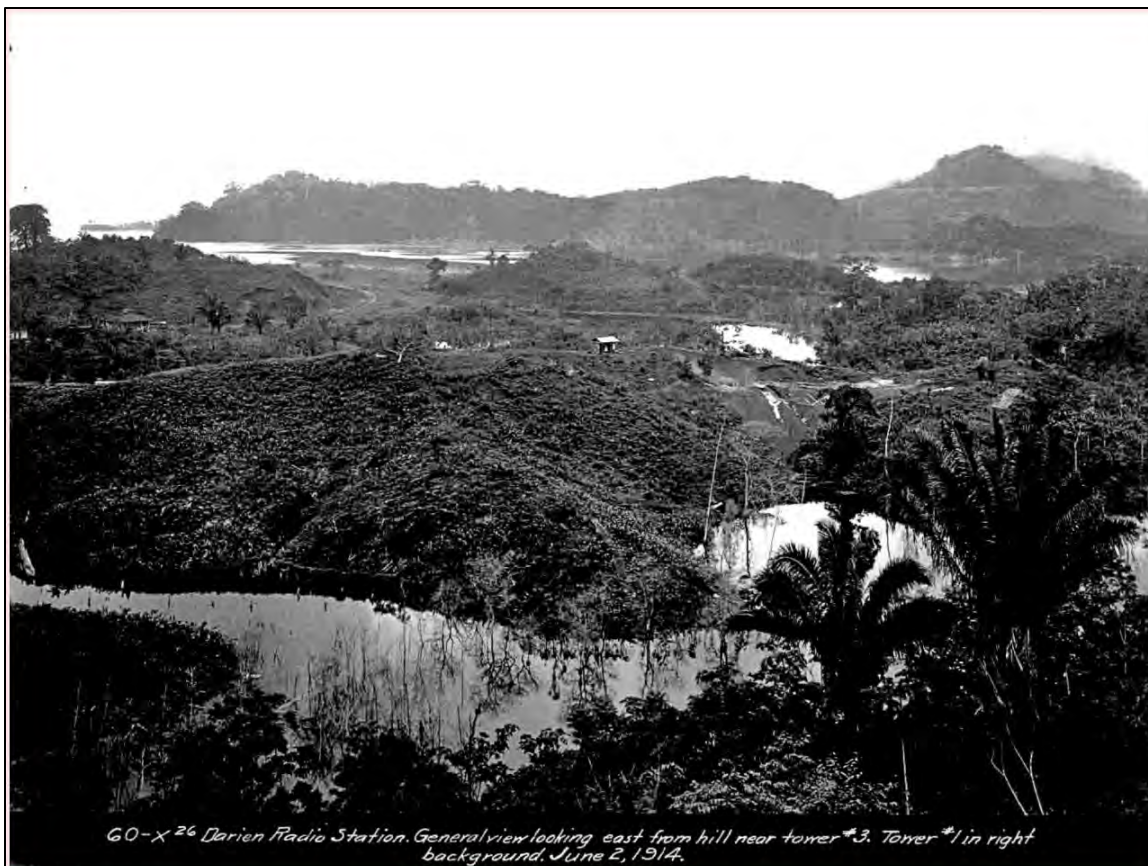


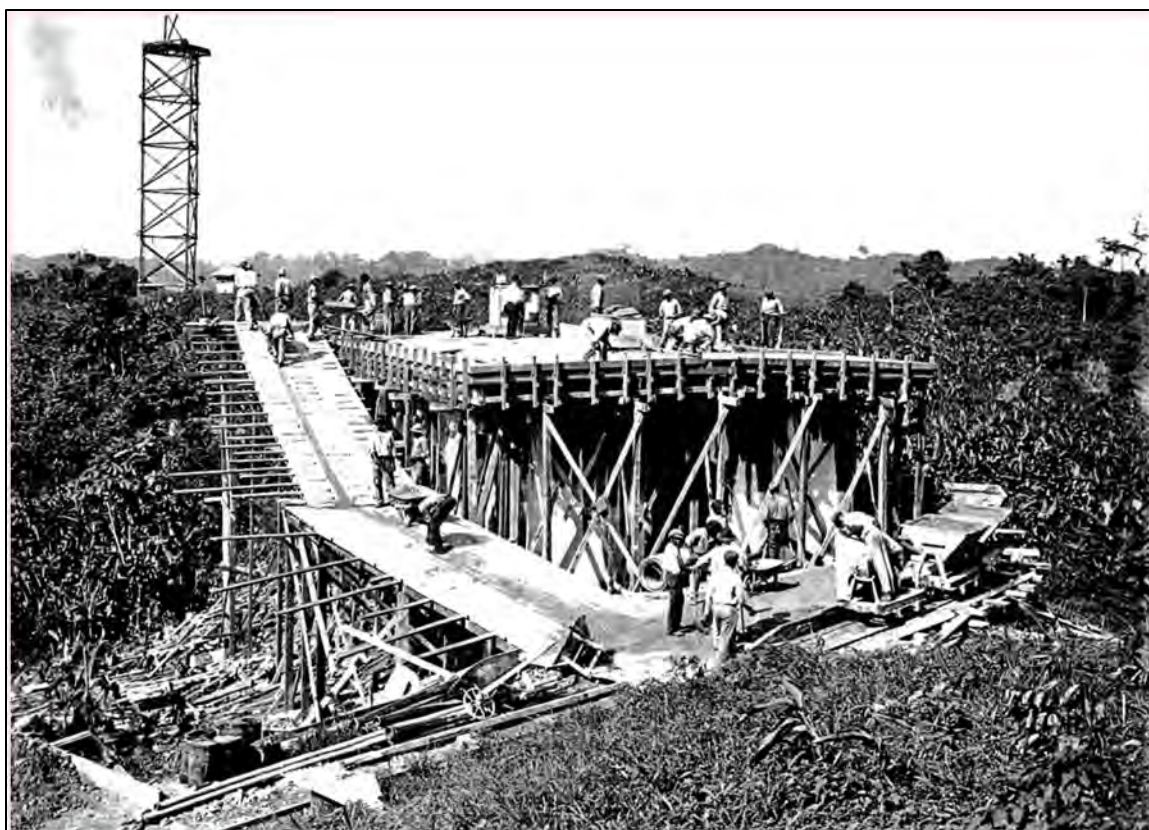
60-X²¹ Darien Radio Station Foundation for leg C, Tower 3. Leg A in background June 2, 1914.



60-X²² Darien Radio Station. Operating building. Contractors' office in background June 2, 1914.







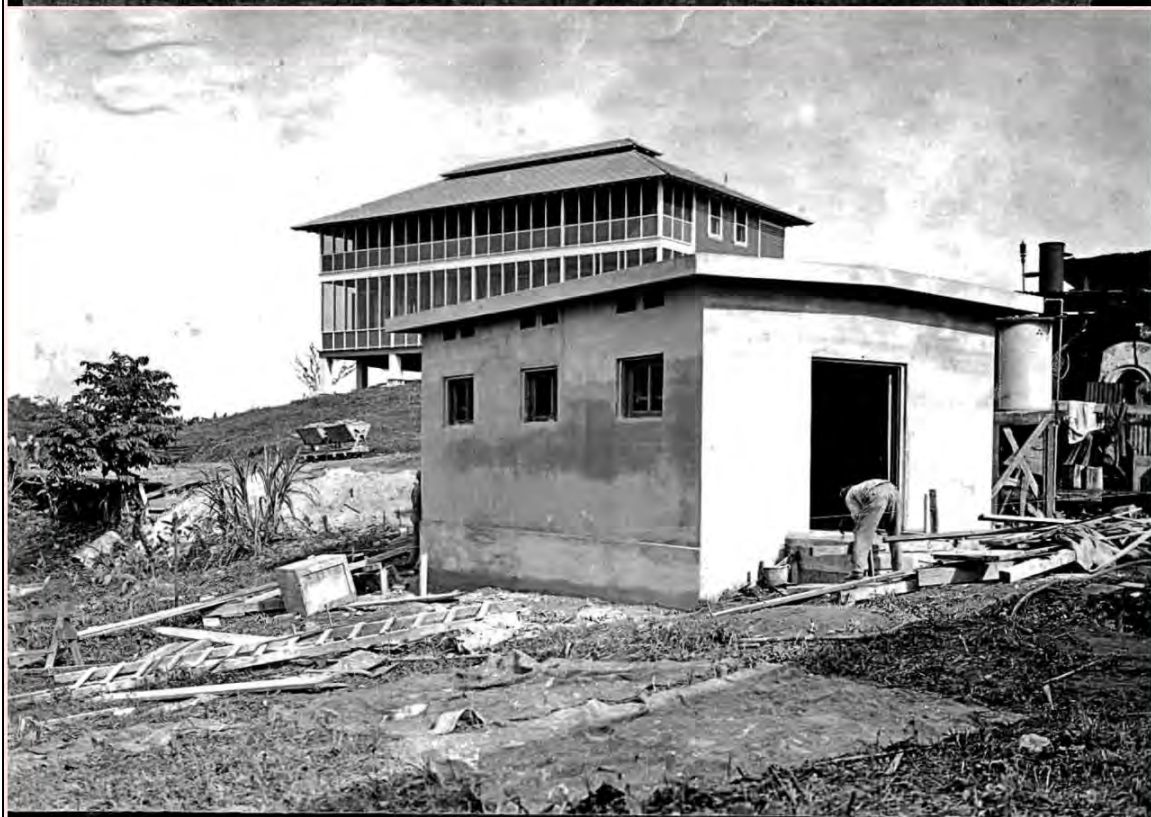
60-X²⁸ Darien Radio Station. Operating Building and falsework for tower 1. July 2, 1914.



60-X³² Darien Radio Station. General view of east end of site. Aug. 5, 1914.



60-X³³. Darien Radio Station, General view of west end of site, showing Tower 1. Aug. 5, 1914.



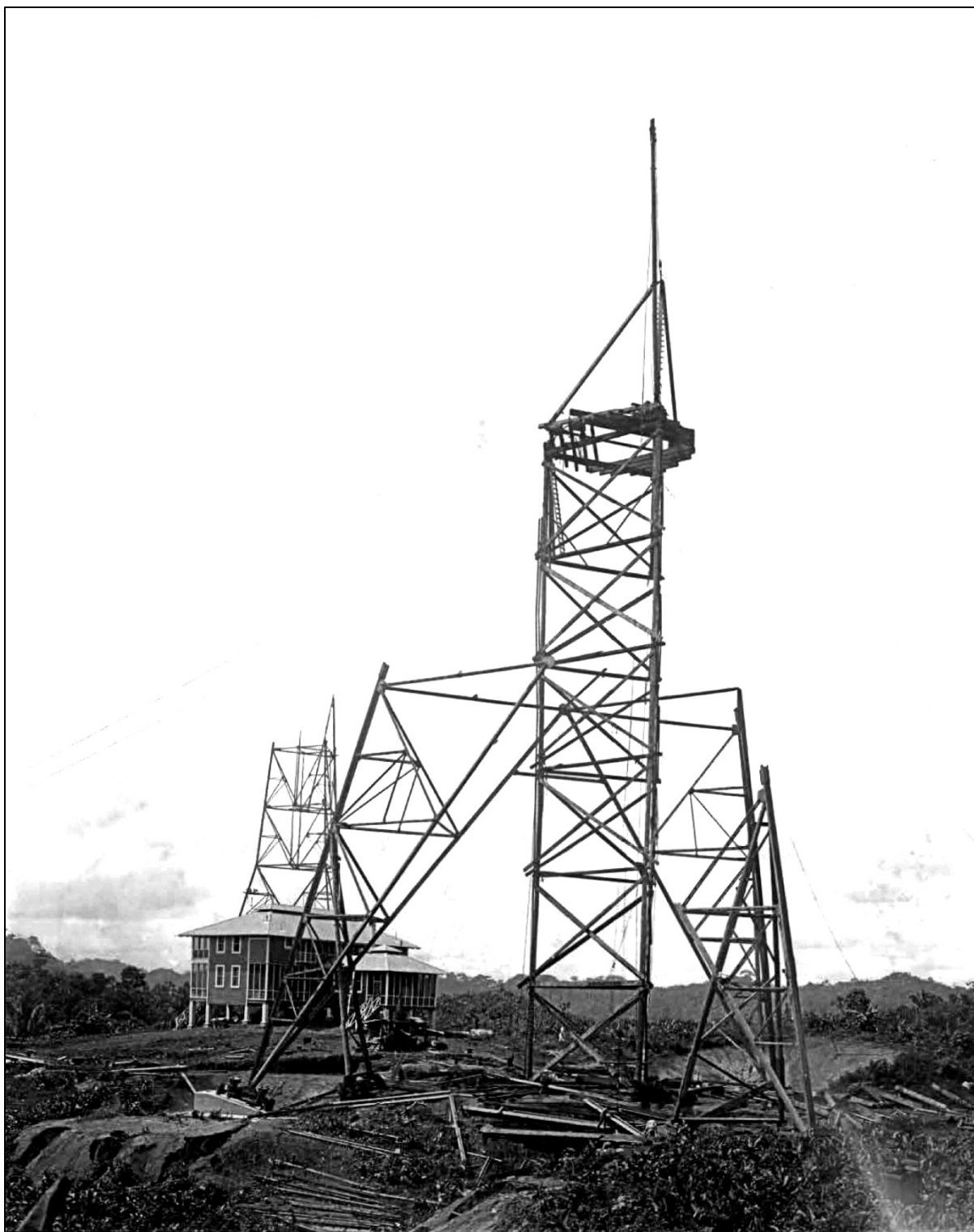
60-X³⁵. Darien Radio Station, Storehouse and Operators' quarters. Aug. 5, 1914.



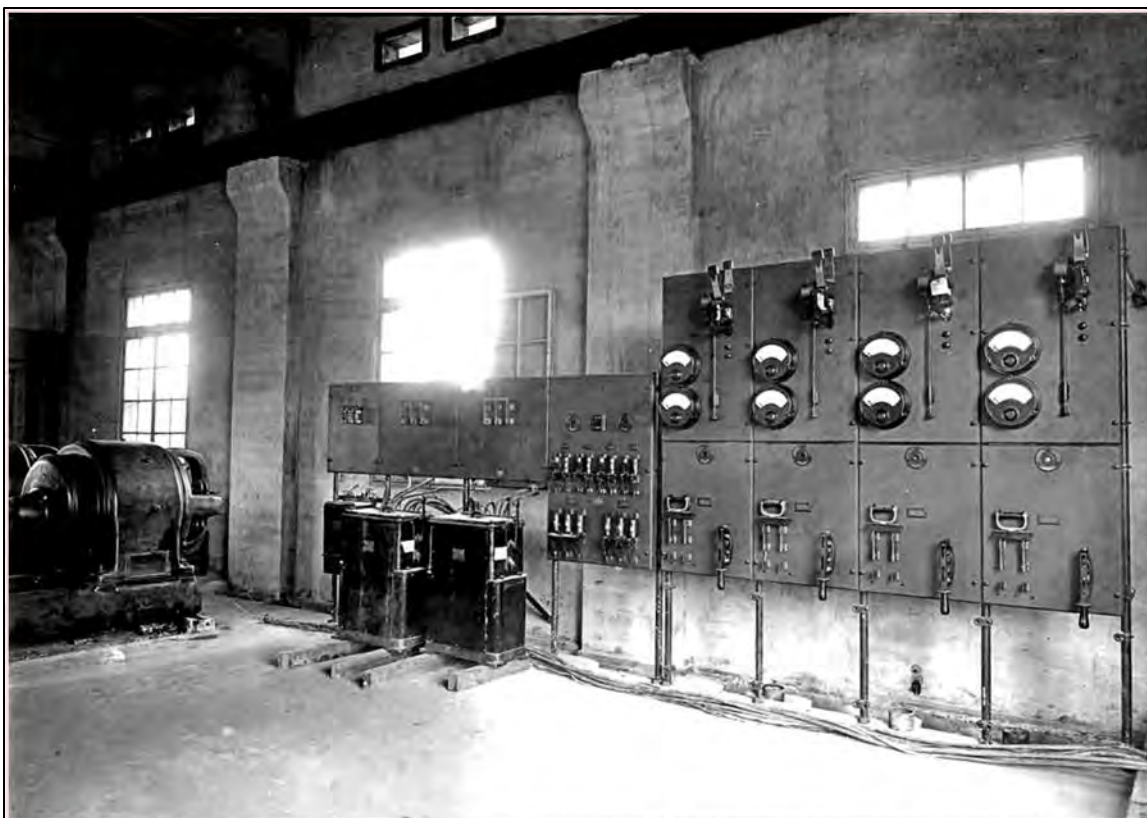
60-X⁴⁰. Darien Radio Sta. C.Z. General view; east end of site. Oct. 5, 1914.



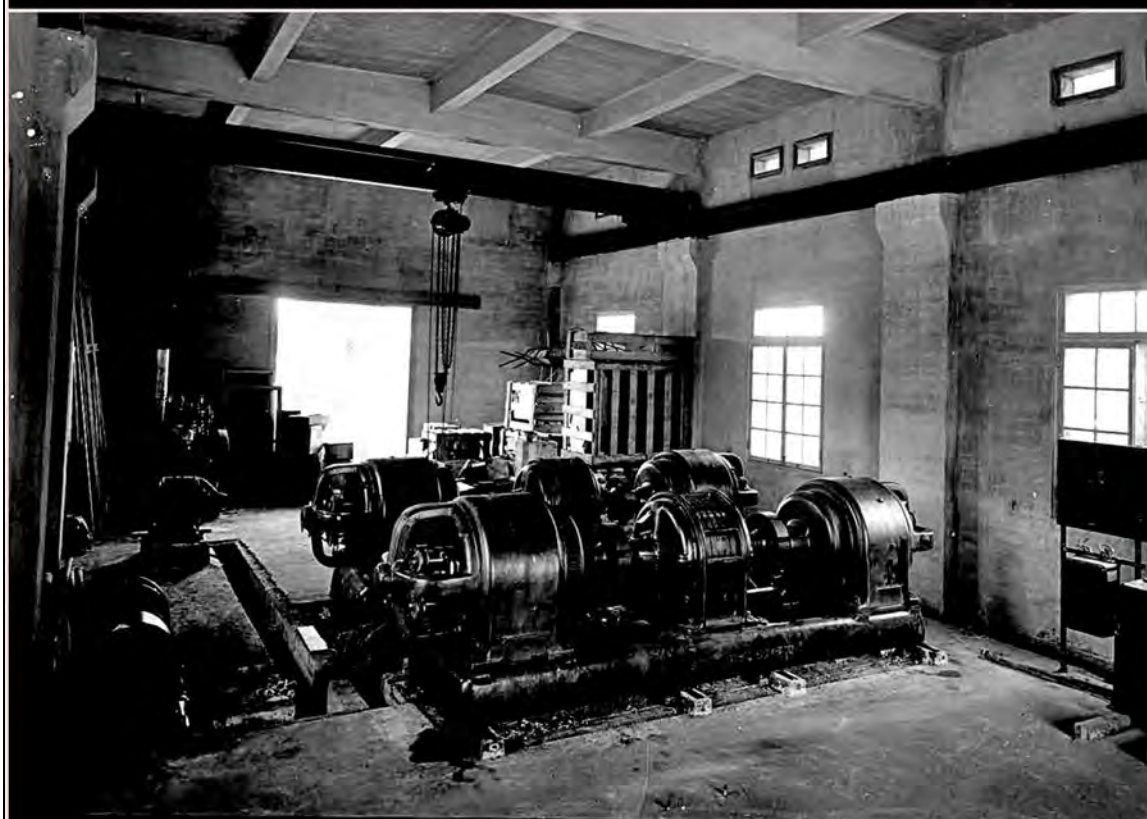
60-X⁴¹. Darien Radio Sta. C.Z. General view; west end of site. Oct. 5, 1914.



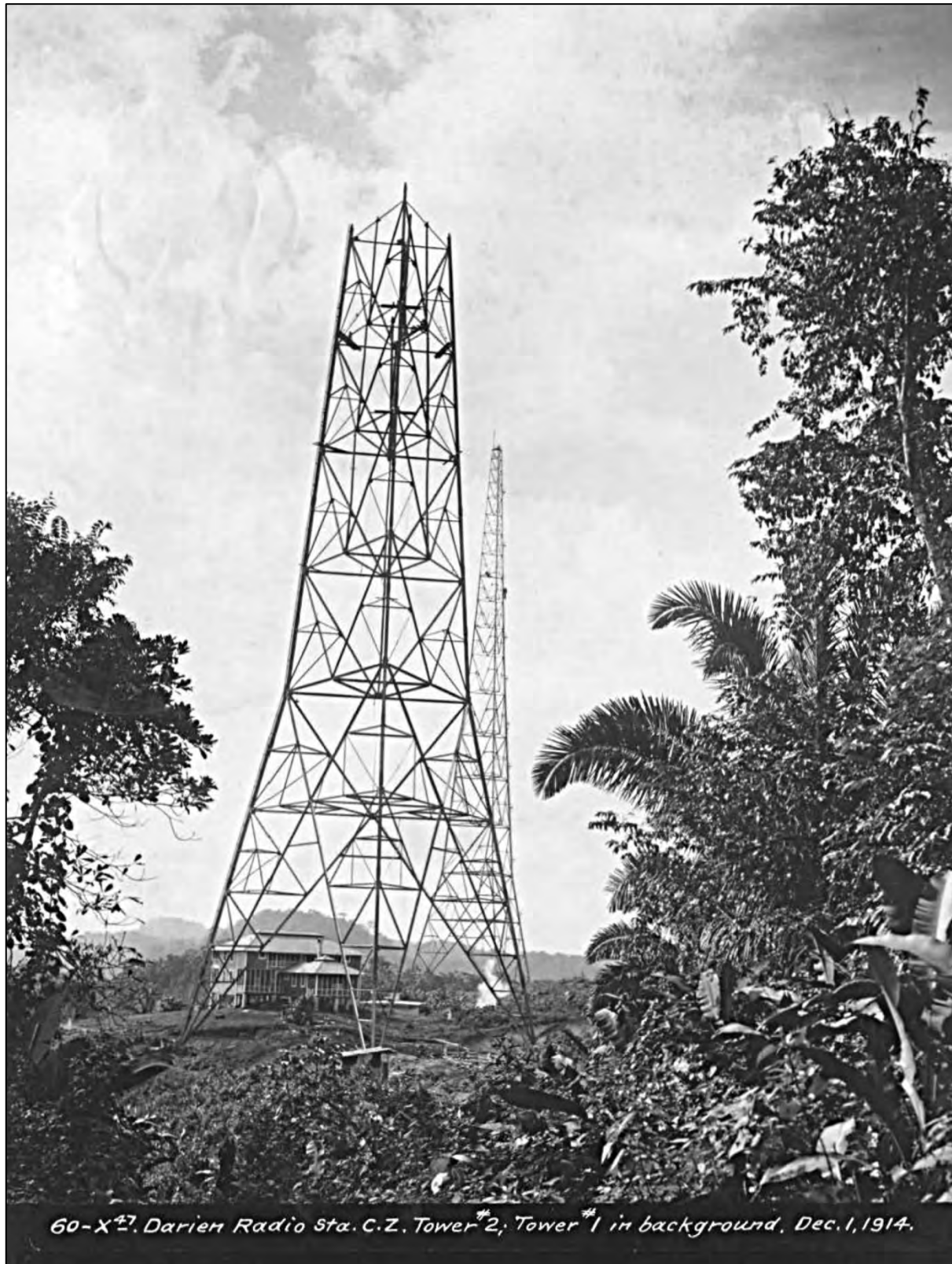
60-X⁴³. Darien Radio Sta. C.Z. Tower #2. Tower #1 in background. Oct. 5, 1914.



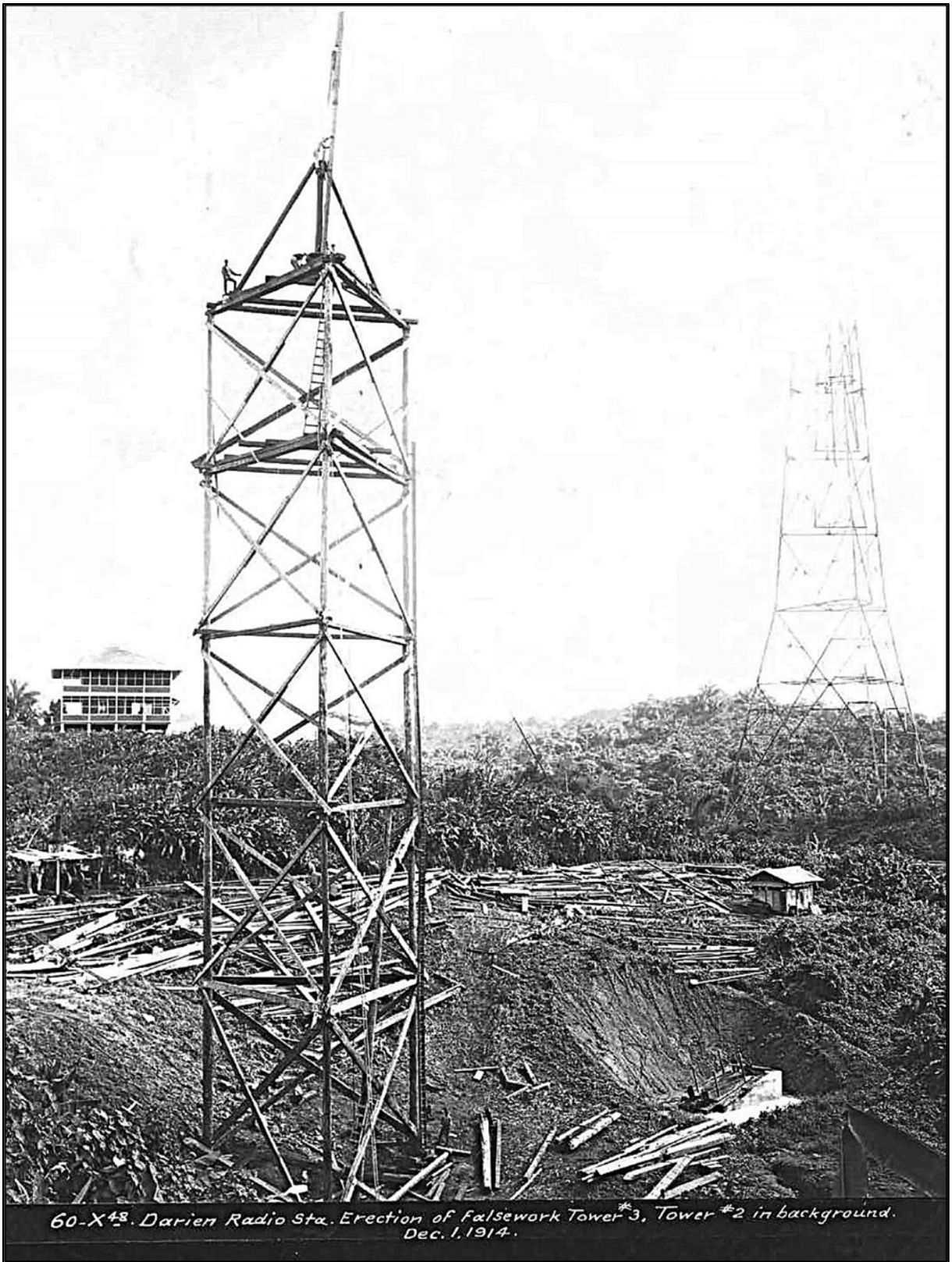
60-X⁴⁵. Darien Radio Sta. C.Z. Interior of Power Ho. showing switchboard. Oct. 5, 1914.



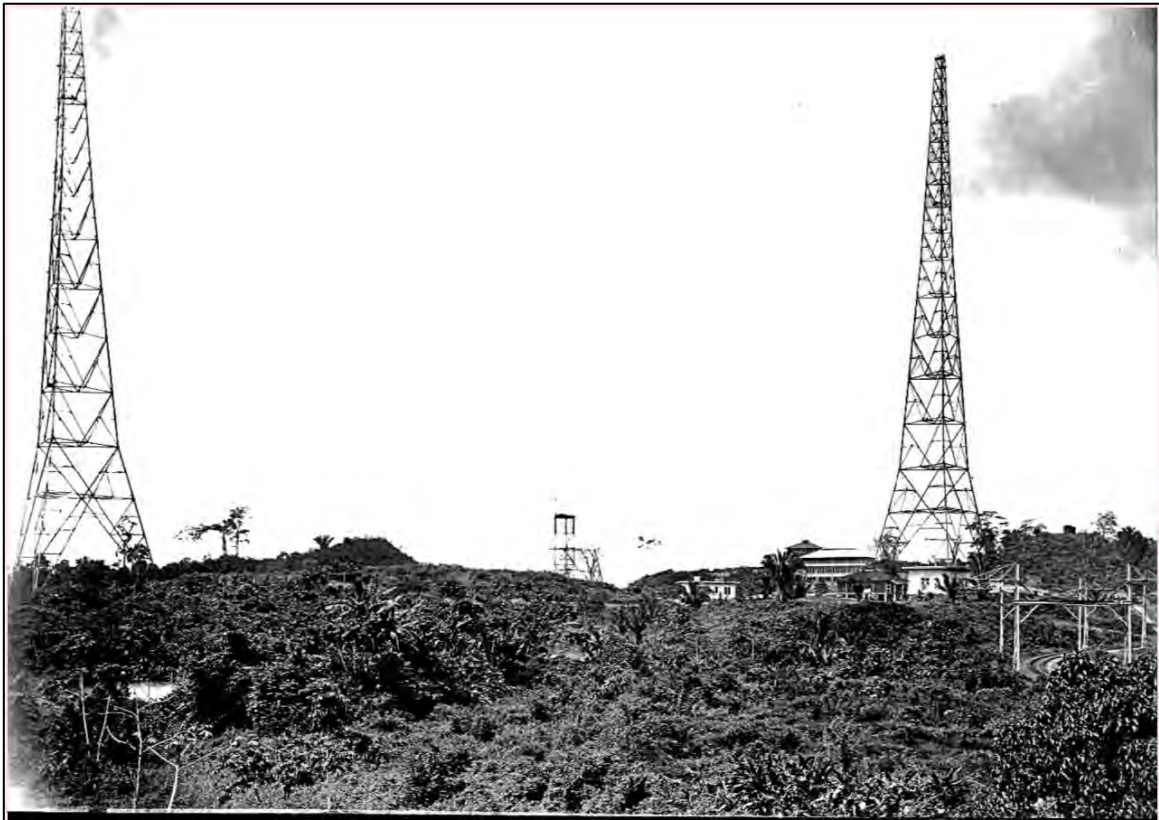
60-X⁴⁶. Darien Radio Sta. C.Z. Interior of Power Ho. showing installation of duplicate 100 h.p. motor-generator sets. Oct. 5, 1914.



60-X⁴⁷. Darien Radio Sta. C.Z. Tower #2; Tower #1 in background, Dec. 1, 1914.



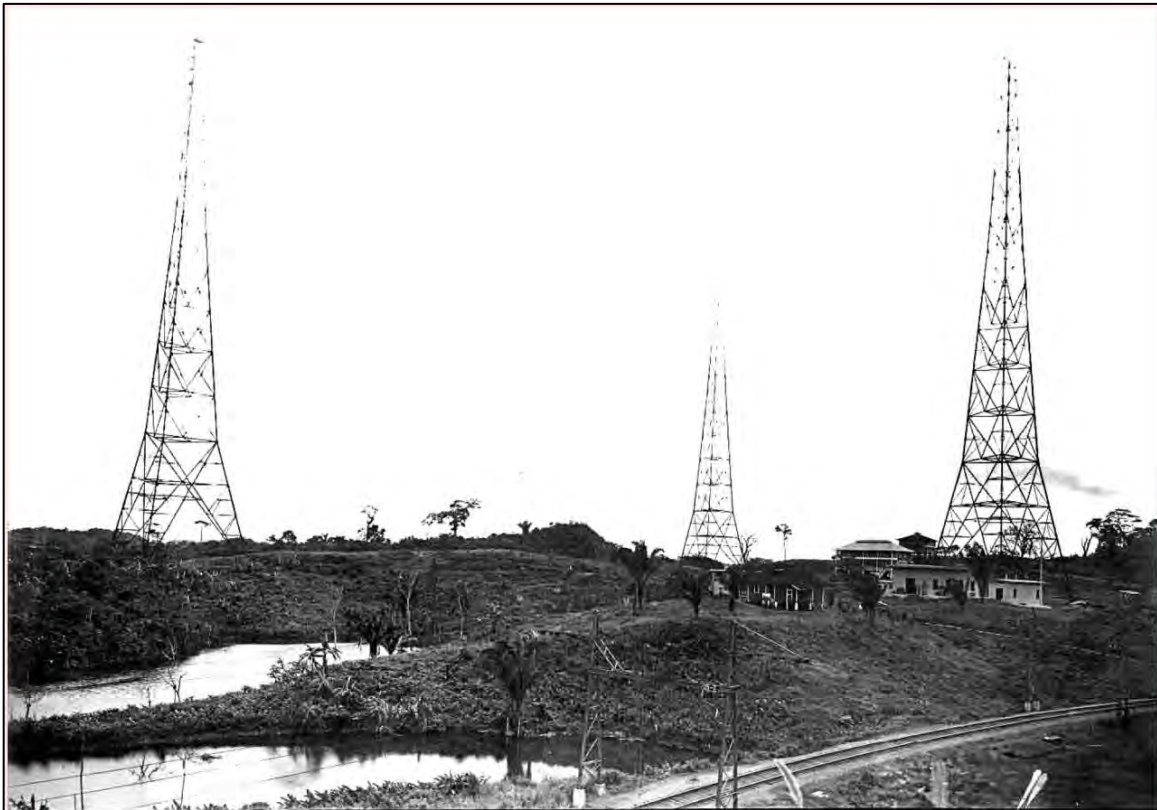
60-X⁴⁸. Darien Radio Sta. Erection of falsework Tower^{*} 3, Tower #2 in background.
Dec. 1, 1914.



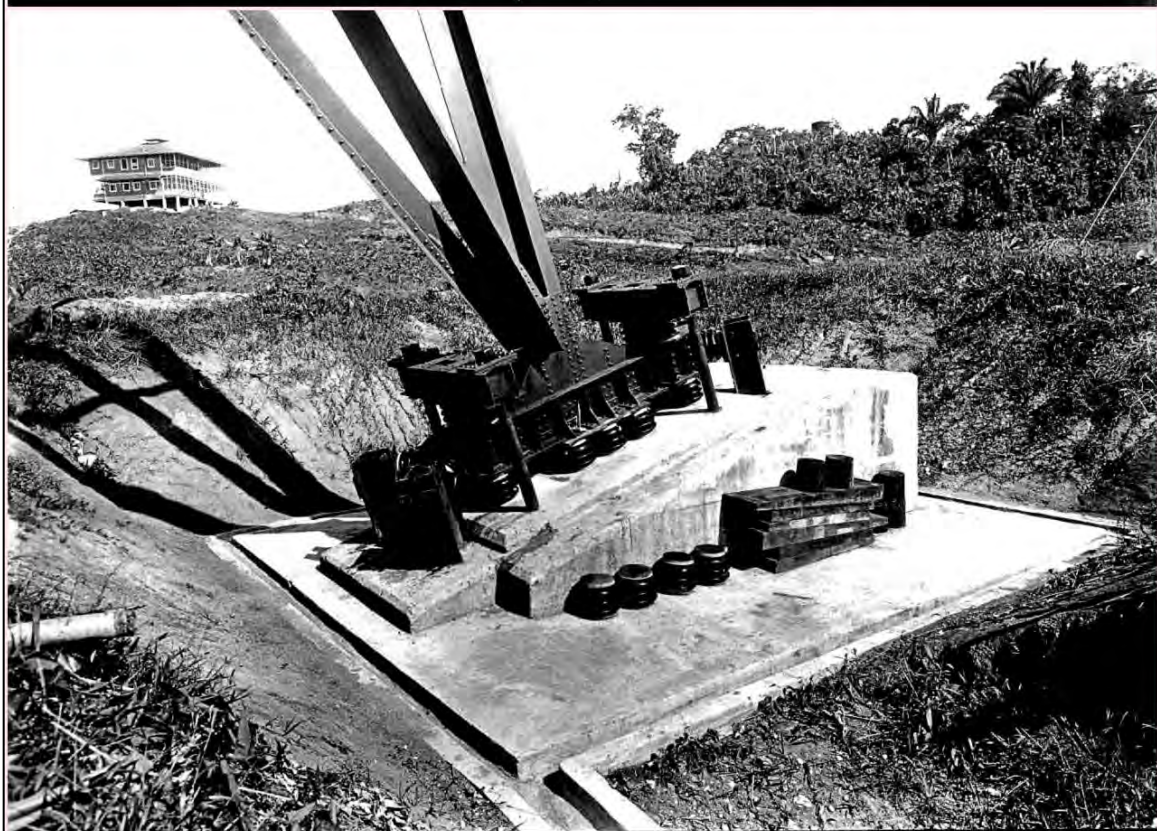
60-X⁵³. Darien Radio Sta. General view of site looking north. Dec. 31, 1914.



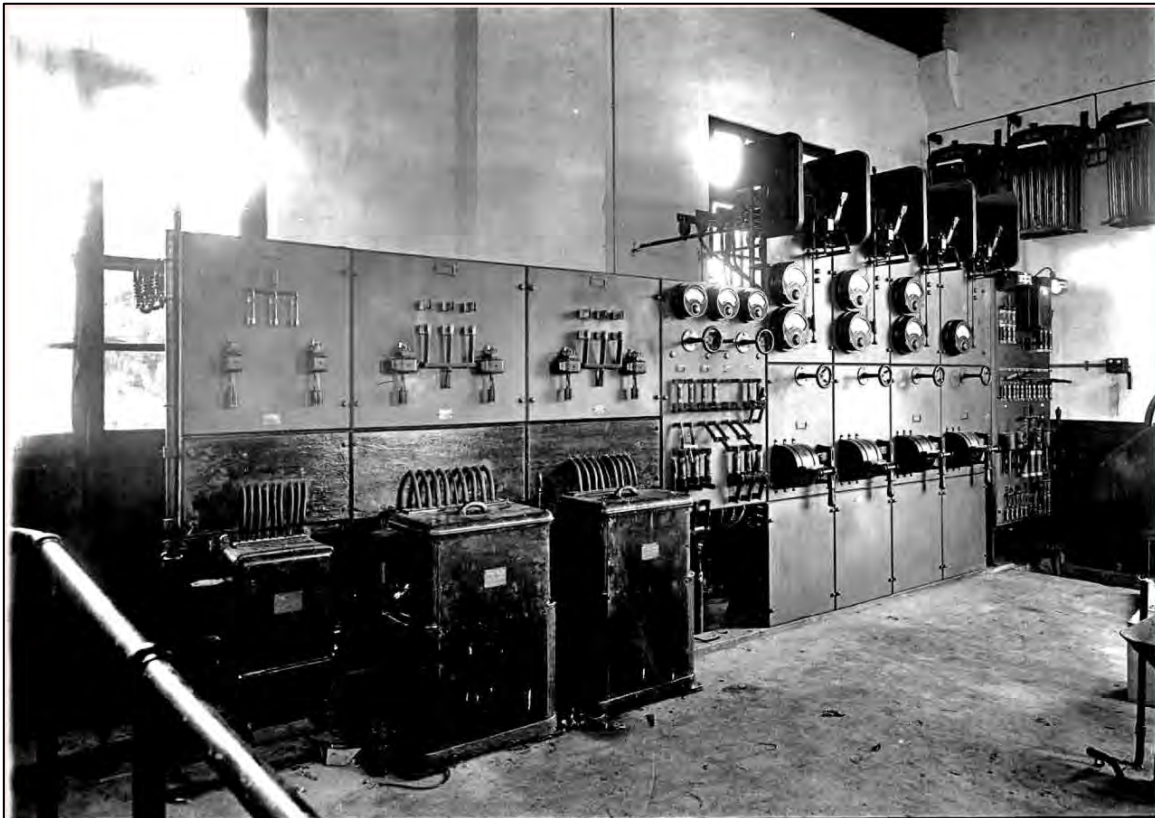
60-X⁵⁸. Darien Radio Sta. View of site from south east. Mch. 8, 1915.



60-X⁶⁵. Darien Radio Sta. General view from hill on east side. May 18, 1915.



60-X⁶³. Darien Radio Sta. Leg A, 1-2, showing insulators in place, wooden blocking removed. May 1, 1915.



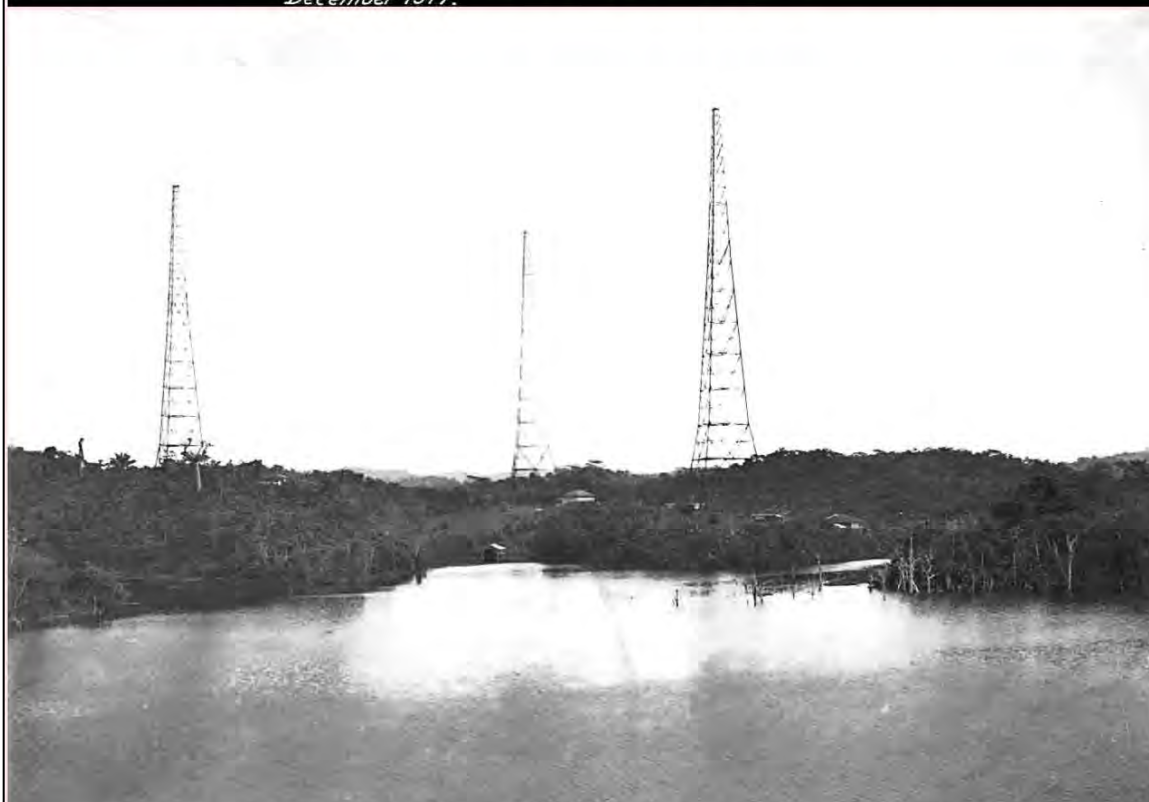
60-X⁶⁴ Darien Radio Sta. Power, lighting and radio switchboard. May 1, 1915.



60-X⁶⁷ Darien Radio Station. Quarters of Commanding Officer. December 1917.



60-X⁶⁸ - Darien Radio Station. Quarters and Grounds.
December 1917.



60-X⁷⁰ - Darien Radio Station From The Lake - Dec. 1916



IX. Now (March 23, 2022)⁵

Images from +/- 100 years ago compared to now highlight the importance of restoring, preserving, and promoting tourism for several reasons:

Historical Significance: The Darien Radio Station, like other heritage sites related to the Panama Canal, represents a crucial period in the history of global trade and engineering. Preserving these sites helps maintain a tangible link to this past, allowing future generations to understand and appreciate the monumental efforts that went into creating the canal.

Cultural Heritage: These sites are part of Panama's cultural heritage, reflecting the country's role in a globally significant engineering project. Restoration and preservation ensure that this cultural heritage is not lost, helping to foster national pride and identity.

Educational Value: Restored historical sites can serve as educational resources for both locals and tourists. They provide real-life contexts for learning about history and international relations, making the past more accessible and engaging.

Tourism and Economic Benefits: Promoting historical sites as tourist attractions can boost local economies. Heritage tourism can generate revenue, create jobs, and support local businesses. Well-preserved and promoted historical sites attract visitors, contributing to Panama's tourism industry.

Preventing Further Deterioration: Abandoned sites are at risk of further decay and potential loss. Restoration efforts can prevent irreversible damage, ensuring that these historical landmarks are protected and maintained for future generations to study and enjoy.

Global Interest: The Panama Canal and its associated sites have worldwide significance. Restoration and promotion can attract international attention, bringing in tourists from around the globe who are interested in the history and engineering feats associated with the canal.

Comparing images from 100 years ago show the current state of the Darien Radio Station, advocates for restoration and preservation can effectively communicate the urgency and importance of saving these historical sites.

⁵ IBID















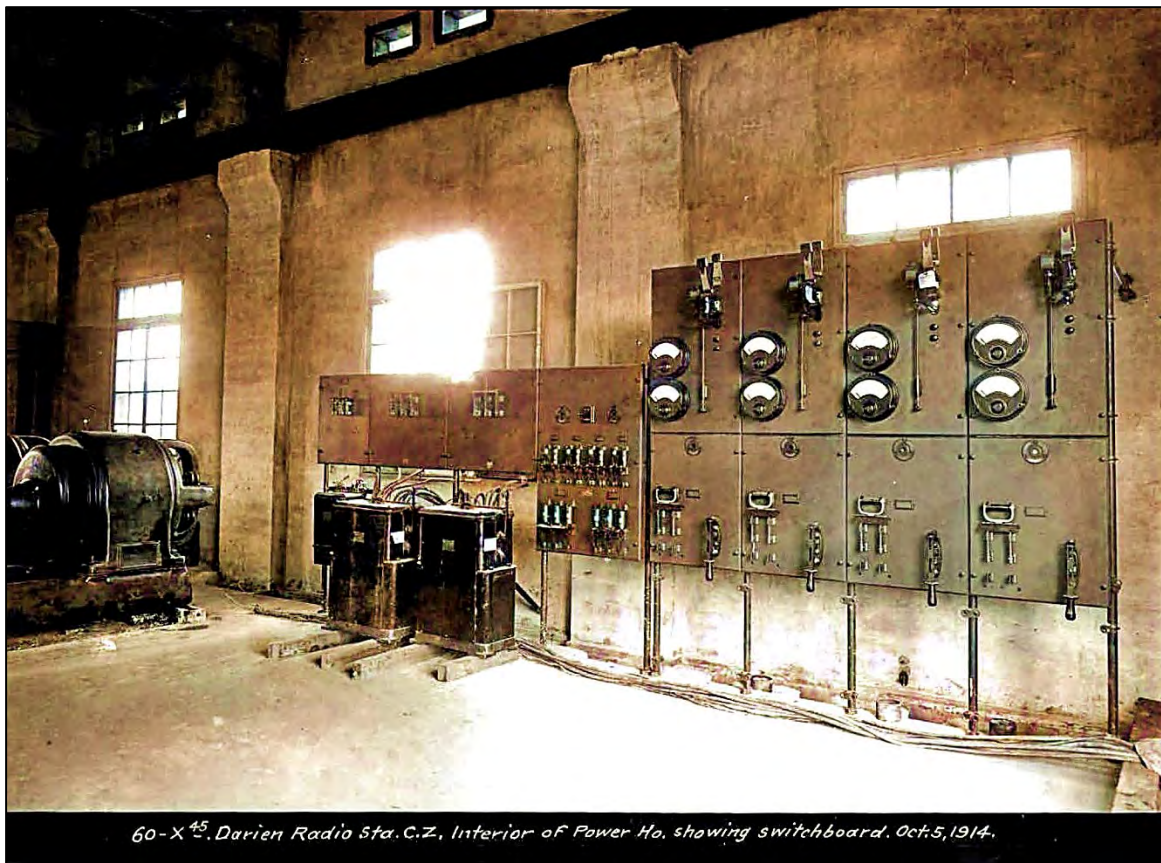


X. Historical Significance and Legacy⁶

At the time of its establishment in the early 1900s, wireless telegraphy was cutting-edge technology. The station helped pioneer long-distance wireless communication, enabling real-time messaging between ships and shore stations. During both World Wars, the station's role became even more critical. It supported military operations, facilitated troop movements, and served as a key communication center for naval forces navigating the Panama Canal.

The advancements and infrastructure developed at the Darien Radio Station laid the groundwork for modern telecommunications. It set a precedent for the integration of radio technology into global maritime operations, influencing subsequent developments in communication technology.

RADIO DARIEN is also significant culturally, symbolizing technological progress and international cooperation during the early 20th century. It represents an era when radio communication transformed global connectivity and navigation.



60-X⁴⁵. Darien Radio Sta. C.Z., Interior of Power Ho., showing switchboard. Oct. 5, 1914.

⁶ IBID

XI. Restoration, Preservation, and Tourism Promotion⁷

Restoring, preserving, and promoting the Darien Radio Station at the Panama Canal is crucial for several reasons:

Cultural Heritage: The station is a testament to early 20th-century technological advancements and a key part of the Panama Canal's history. Preserving it maintains a tangible link to the past. This can inspire new innovations and appreciation for the progress made in the field of telecommunications.

Educational Value: Restored sites can serve as educational resources, offering insights into the evolution of communication technology and the strategic importance of the Panama Canal. Schools and universities can use the site for field trips, projects, and research, enriching their curriculum with hands-on learning experiences.

Attracting Visitors: As a historical site, the Darien Radio Station can attract tourists interested in history, technology, and maritime heritage, boosting local tourism.

Economic Development: Increased tourism can lead to economic growth in the surrounding area, providing jobs and stimulating local businesses.

National Pride: Restoring and preserving such sites reinforces national identity and pride, showcasing Panama's role in global maritime history and technological innovation.

Community Engagement: Involving the local community in preservation efforts can foster a sense of ownership and connection to their heritage.

Historical Research: The station can be a focal point for researchers studying early radio communication, maritime history, and the development of the Panama Canal.

International Interest: The Panama Canal is a site of international importance. Promoting this site can draw interest from a global audience, enhancing Panama's status as a destination for cultural and historical tourism.

By focusing on restoration, preservation, and promotion, the Darien Radio Station can become a valuable cultural and educational asset, contributing to both the local and global appreciation of Panama's rich historical heritage.

⁷ IBID

XII. Executive Order 7399 - Reservation of Naval Radio Station, Summit, Canal Zone.

By virtue of and pursuant to the authority vested in me by section 5 of title 2 of the Canal Zone Code, approved June 19, 1934, and as President of the United States, the following-described area of land in the Canal Zone is hereby reserved and set apart as, and assigned to the uses and purposes of, a naval reservation, which shall be known as U.S. Naval Radio Station, Summit, Canal Zone, and shall be under the control and jurisdiction of the Secretary of the Navy, except that it shall be subject to the civil jurisdiction of the Canal Zone Government in conformity with the provisions of the said Canal Zone Code...



FRANKLIN D. ROOSEVELT

*32nd President of the United States: 1933
- 1945*

Executive Order 7399— Reservation of Naval Radio Station, Summit,

Canal Zone

June 23, 1936

The above-described area was surveyed by the Section of Surveys, the Panama Canal, in February 1936, and is as shown on Panama Canal Drawing 6103-73, dated March 31, 1936, titled 'U.S. Naval Radio Station, Summit, C.Z.', showing approval by the Governor of the Panama Canal and by the Commandant, Fifteenth Naval District, in whose offices the drawing is filed.

FRANKLIN D. ROOSEVELT, THE WHITE HOUSE, June 23, 1936.

Publications at AMAZON BOOKS / Keywords: "Jaime Massot" - Books printed in the United States of America					
#	Title	Date	Size	Pages	Language
1	<i>El Panamá de Ayer y Hoy "En Imágenes": 1904-1938</i>	2008-12	8.5 x 11	188	Spanish
2	<i>El Panamá de Ayer y Hoy "En Imágenes"</i>	2011-05	8.5 x 11	208	Spanish
3	<i>El Panamá de Ayer y Hoy "En Imágenes"</i>	2012-06	8.5 x 11	182	Spanish
4	<i>Voluntad para lograr lo imposible</i>	2011-03	8.5 x 11	458	Spanish
5	<i>El Casco Antiguo de Panamá en lápices de colores</i>	2015-08	8.25 x 6	102	Spanish
6	<i>El Casco Antiguo de Ayer y Hoy: 140 años de historia en imágenes (1875-2015)</i>	2015-09	8.5 x 11	24	Spanish
7	<i>El Panamá de Ayer y Hoy - Tres siglos en imágenes</i>	2015-09	8.5 x 11	106	Spanish
8	<i>Un paseo por la ciudad hace más de 100 años</i>	2015-10	8.25 x 6	30	Spanish
9	<i>Ayer y Hoy: Centenario del barrio de La Exposición (1916-2016)</i>	2016-08	8.5 x 11	26	Spanish
10	<i>Conjunto Monumental Histórico del Casco Antiguo y periferia</i>	2016-08	8.5 x 11	102	Spanish
11	<i>Diccionario Ilustrado de Panameñismos</i>	2016-12	8.5 x 8.5	200	Spanish
13	<i>Panama Canal Zone - Then and Now: "A land divided, a world united."</i>	2016-12	8.5 x 11	158	English
14	<i>Imágenes de mi Panamá en 100 páginas</i>	2017-01	8.5 x 11	102	Spanish
15	<i>Monumentos históricos de Panamá según la enciclopedia libre Wikipedia</i>	2017-02	8.5 x 11	238	Spanish
16	<i>Un paseo por la ciudad de Panamá: Photowalk 2015</i>	2017-05	8.5 x 11	46	Spanish
17	<i>Visitas de interés para los turistas (1926): En postales de principios del siglo XX</i>	2017-06	8.5 x 11	112	Spanish
18	<i>Casco Antiguo and surroundings: 10 years in colored pencils</i>	2017-12	8.25 x 6	212	English
19	<i>Análisis del Sistema de Ascenso por Mérito en la Comisión del Canal de Panamá</i>	2017-12	8.25 x 11	130	Spanish
20	<i>Análisis de las Conclusiones del Estudio de las Alternativas al Canal de Panamá</i>	2017-12	8.25 x 11	136	Spanish
21	<i>El Casco Antiguo y alrededores: Diez años en lápices de colores</i>	2017-12	8.25 x 6	212	Spanish
24	<i>Panama Canal Construction (1904-14): Postcards, Tales and Facts</i>	2017-12	8.5 x 11	480	English
25	<i>El Panamá de Ayer y Hoy - En Imágenes: X Aniversario (2008-2018)</i>	2018-06	8.5 x 11	178	Spanish
12	<i>Diez años en la cuenca del Canal de Panamá</i>	2018-09	8.5 x 11	66	Spanish
26	<i>El Panamá de Ayer y Hoy: En fotos, planos y mapas</i>	2018-12	8.5 x 11	178	Spanish
27	<i>From Colon to Panama (1912): Illustrated with historical photos, postcards, documents and maps</i>	2019-06	8.5 x 11	480	English
28	<i>Proyecto de renovación de la ciudad de Colón (2014-2019) - Lo bueno, lo malo y lo feo</i>	2019-08	8.5 x 11	94	Spanish
29	<i>THE PANAMA CANAL 100 YEARS AGO: Illustrated with 100 colored photographs, history and family stories (1920)</i>	2020-12	8.5 x 11	144	English
30	<i>Taboga Island photographs by Ernest "Red" Hallen: Tales and historical information</i>	2022-04	8.5 x 11	58	English
31	<i>DARIEN RADIO STATION - Restoration, preservation, and tourism promotion of some Panama Canal historical sites in abandonment</i>	2022-12	8.5 x 11	110	English

Upcoming publications:

- PANAMA and the CANAL 100 YEARS AGO - Illustrated with colorized photographs and stories (1924).
- AGUA CLARA FILTRATION PLANT - 'THEN (1910-1944) AND NOW (2022): Restoration, preservation, and tourism promotion of some Panama Canal historical sites in abandonment.
- GATUN TOWN - 'THEN (1912-2000) AND NOW (2022): Restoration, preservation, and tourism promotion of some Panama Canal historical sites in abandonment.